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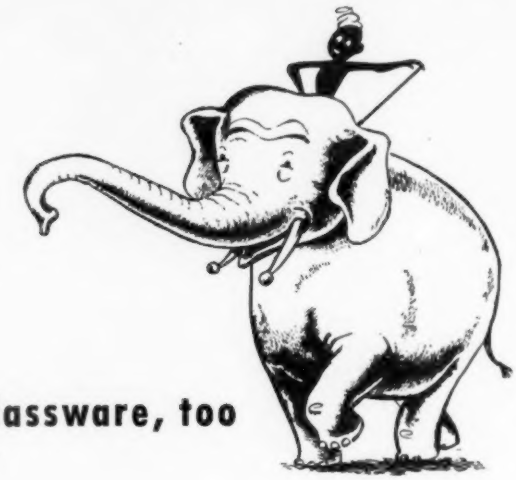
THE SCIENCE TEACHER

JOURNAL OF THE NATIONAL SCIENCE TEACHERS ASSOCIATION



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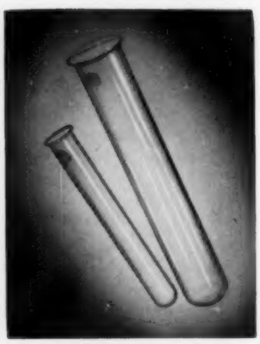

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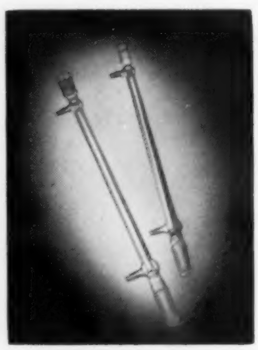

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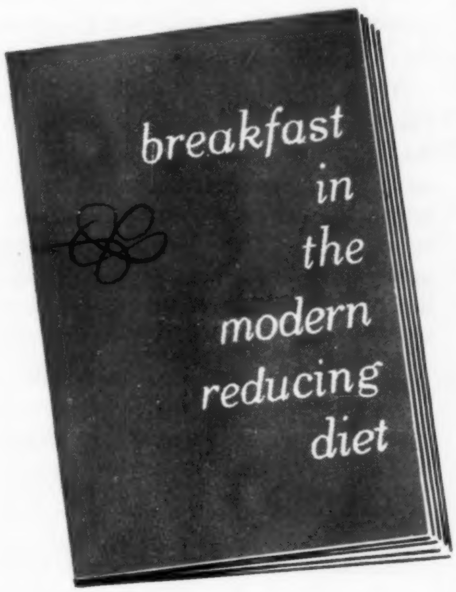

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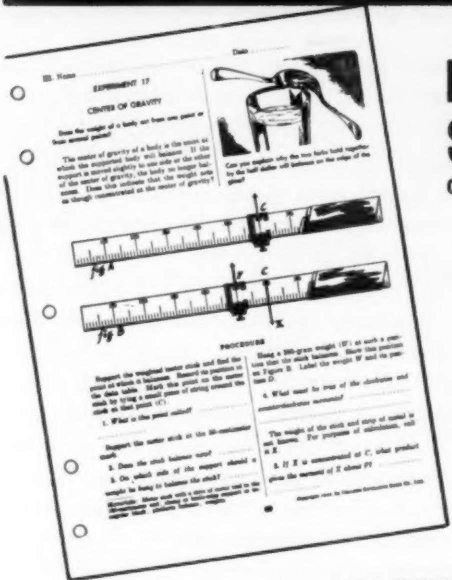

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Guided Missives

I have just received the program of the First National Convention of the National Science Teachers Association. I am surprised and gratified to see the extensive program that it has been possible to get together. I am sure that all other charter members of the Association, recalling its humble beginnings a few years ago, would join with me in saying that the organization has exceeded our hopes in the early days. My personal congratulations to all those who have been instrumental in organizing this meeting! I only regret that I am not able to be present.

Another thing that strikes me very forcibly is that though I was actively associated with all science teaching developments only a few years ago, I recognize no more than a half-dozen names on this program. That is as it should be, of course, and I congratulate the Association upon the new workers who are appearing.

My personal regards to you.

W. L. EIKENBERRY
Polo, Illinois

EDITOR'S NOTE: One of our big thrills of the Convention occurred when Arthur O. Baker read this letter to a general session at which he presided. Perhaps the younger members of NSTA need reminding that Dr. Eikenberry was one of the "fathers" of the general science movement, adding his impetus to its growth through his writings and teaching as early as forty years ago. Now well past 80 years of age (and still hale and hearty), he lives in retirement on his farm in Illinois. We did indeed appreciate his message and send in return our regards and best wishes.

It was a pleasure to attend your First National Convention in Pittsburgh. It was a fine meeting and I was proud to be a part of your outstanding program. Miss Picard of our National Office, who was in attendance at our American Cancer Society booth, was most complimentary concerning the manner in which the entire Convention was conducted. Our congratulations for this First National Convention and our warm good wishes for 1954!!

JANET SHAIR
American Cancer Society
New York City

THE SCIENCE TEACHER

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May I congratulate the Association on making the First National Convention such a tremendous success. I enjoyed it thoroughly and I took from it valuable new techniques and knowledge. I hope to see you and others at the Chicago convention.

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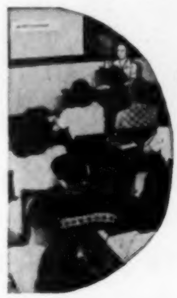

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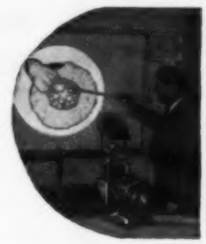

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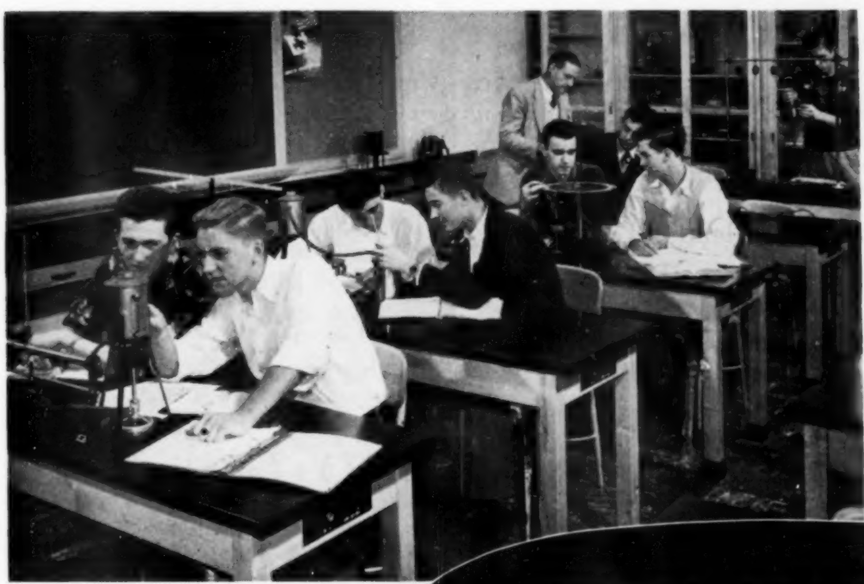

*Kibbee Streetman of West End High School, Birmingham, Alabama, winner of First Place Award in 1952 NSTA-ASM Science Achievement Awards program, division of grades 7-10.

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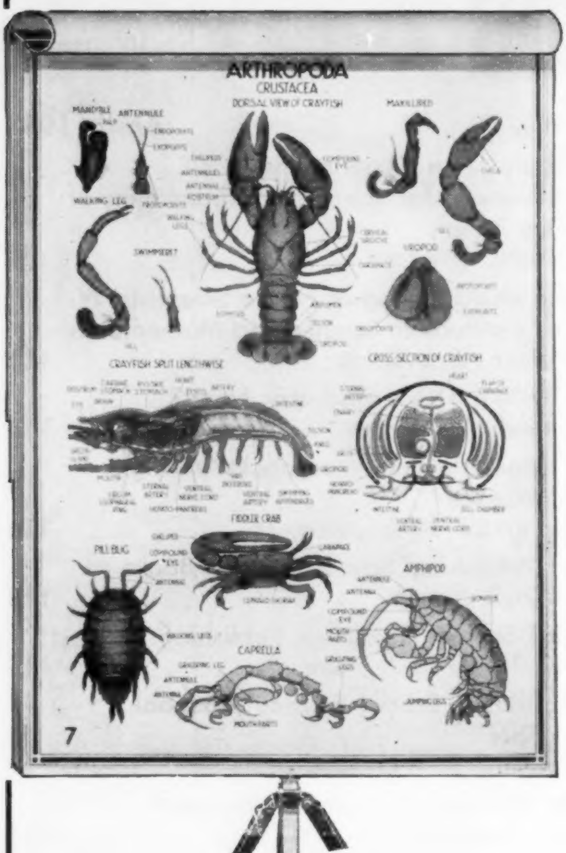

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THE FORD FOUNDATION EXPERIMENTS—

Their Implications for the Science Education of High-Ability Youth

By MORRIS MEISTER

THE FORD FUND for the Advancement of Education has thrown a profound challenge to the schools and colleges of the nation. By making available its "risk capital" to support certain short and long range programs in education, it seeks to reduce what it regards as confusion concerning the functions of school and college. It is especially interested in what happens to able young people in grades eleven through fourteen. It believes that the effectiveness of education in these grades is especially poor; that many studies in the past have pointed to duplication of effort and waste of money; that high school graduates come to college with poor study habits and poor ability to write and to speak, and that their instruction in science and mathematics leaves much to be desired.

As viewed by many on the outside, the Ford Fund is stimulating a ferment of discussion. It is also clear, however, that the Fund wants more than mere discussion. The design of each of the Ford programs has in it a dynamic quality of action from which, they hope, some basic changes for the better will flow into the pattern of American education. Whether or not one believes in the premise with which the Fund begins, the procedures are admittedly bold and attractive. One can not help but recall the expensive efforts of another Foundation, about a dozen years ago, in a somewhat similar field—The Eight Year Study—from which there is so little residue in the schools and colleges of today.

Since all four of the Ford programs to which I shall refer are for educating youth of top-ability levels, it may be helpful to first review a number of ideas and considerations that are pertinent to this symposium.

First, it must be admitted that the intellectual human resources of any nation are finite. According to Terman, Witty, Wolfle, and others, not more than a third of the individuals in an age group can be educated for intellectual work. From this segment of the population come nearly all of our scientists, scholars, lawyers, teachers, writers, inventors, artists, musicians, etc. They contribute to civilization out of all proportion to their number.

Second, it is vital to welfare and to progress that these individuals be identified early, so that they get educational experiences to maximize their potential for achievement. Differential education for them is not preferential treatment. Equality of educational opportunity should not mean equality of educational exposure. It is more important that each individual attain his maximum, than that *all* shall reach some minimum achievement.

Providing adequate education for youth of high ability has always been difficult; yet the difficulties were not too critical when a major portion of the young people in high schools were college-bound or drawn from top-ability levels. Today, more than eighty per cent of youth of high school age are in high school. Not only is this percentage increasing, but the total numbers in secondary schools will shortly reach the peak made inevitable by the large numbers now in elementary schools.

Increasingly, schools are compelled to reorganize administrative, curricular, and teaching procedures to care for the generality of the population. As a result, youth of high ability are no longer in the focus of attention. They are often neglected on the false assumption that the bright can take care of themselves. That too many of them do not, is indicated by an increasing volume of criticism from the colleges and the sharp concern of educators everywhere for the waste of human talent, both in quality and in quantity.

Recognizing this, some schools have devised special curricula, different kinds of school organization, and a variety of teaching procedures in the hope of preventing such waste. Among the measures employed are homogeneous grouping, honors

classes, honor schools within schools, specialized high schools, acceleration, enriched curricula, and programs of closer articulation between school and college. It is unfortunately true, however, that most of the 26,000 American high schools do little to meet the problem.

Acceleration and Enrichment

Two simple approaches are possible: Allow students to obtain a given amount of education in less time (acceleration). Or, give them more education in the same time (enrichment). But what seems to be a simple approach, turns out to be incredibly complicated, as we deal with real children, in actual classrooms of specific schools manned and administered by available teachers and principals. The kind of child who can accelerate also gets some enrichments in the process. Also, he may or may not be losing in other ways, not readily measureable. Assuming that there *are* some losses, the latter are usually determined by whether he deviates markedly from the norm of his group. If he is in a large company of accelerants, he may not be subject to social or emotional imbalance. Should enrichments rather than acceleration be provided for him, individualized demands quickly outstrip the possibilities of the teacher's available time, energy, facilities, recources, and training. As a result, only a modicum of enrichment can ever be offered and the needs in some areas for all individuals are often neglected.

Acceleration and enrichment can not be treated as a dichotomy. It is not a question of either, or; but of how much of each? Each has its values and each its evils. There is as much danger of social and emotional imbalance from retardation as from acceleration. The question, as Terman puts it, is "How much risk of maladjustment can one afford to take in order to keep the gifted child at school tasks difficult enough to command his attention and respect. . . . No universal rule can be laid down governing the amount of acceleration that is desirable."

Fundamental studies are needed in this area. We will know when to take calculated risks in the education of children when we know more about the nature of intellectual and social growth in individuals of different ability levels. Can we identify at the eighth-grade level the kind of child who can do the four year high school course in three years or two? And what, if anything, does he lose in the process? By what techniques may this loss be minimized? What kind of individual can be safely accelerated and/or enriched, to what extent, and how?

The essence of the St. Louis meeting last December continues to distill off for the benefit of readers of *TST*. Fountainhead of the two lead articles in this issue was the AAAS Cooperative Committee symposium, "Identification of Talented Youth in Science and Mathematics." Morris Meister's discussion of the Ford Foundation experiments and Paul Brandwein's fourth contribution on the selection and training of future scientists (starting on page 111) are indeed informative and provocative; they raise several questions which science teachers must bear in mind as we strive to deal more adequately with the able students in science.

Neither of these authors needs much introduction. Science teacher and author of science texts, Meister is principal of the High School of Science in New York City; is chairman of the Cooperative Committee; a past president of NSTA. Brandwein is biology teacher and head of the science department at Forest Hills, New York, High School; teaches part-time at Columbia University's Teachers College; is science text author and editor with Harcourt, Brace and Company.

Of the other two papers presented in the symposium, Mallinson's has been published elsewhere and is given as reference 7 in Brandwein's bibliography. Brown's paper will likely appear in *The Mathematics Teacher*.

In terms of these fundamental considerations, let us now review briefly each of the four Ford programs.

The Three School—Three College Plan

This study was sponsored by Andover, Exeter, and Lawrenceville and the three colleges which admit a substantial number of their graduates—Harvard, Yale, and Princeton. First, the complete academic records from the eleventh grade through college of 344 graduates from the three schools in the class of 1951 at the three colleges were examined and analyzed. Secondly, surveys were made of how 10 different subjects are taught in grades eleven through fourteen in these six institutions. Third, a 20-page questionnaire of the essay type was administered to 58 graduates of the three schools in the class of 1952 at the three colleges. Fourth, 13 panel discussions were held with many guest consultants on fields of study essential to a liberal education and the relation between school and college in each field.

All the evidence gathered pointed to three main weaknesses:

1. Schools and colleges were doing much the same thing twice. This was especially true in the sciences, where duplication of work showed that the repeaters had only a very negligible advantage.
2. Subjects were being dropped in high school before they had really done much good. This was notably the case in the study of foreign languages.
3. Less important aspects of a subject were being emphasized at the expense of the more important. This was especially true in mathematics.

To meet these weaknesses, the program proposes:

1. A series of placement tests under the auspices of the College Entrance Examination Board. These will be used for proper placement in college after admission.
2. A program of general education in high school was developed based on the principle of "progression

in strength." That is, able students who have found a particular intellectual interest early in life, will be given the opportunity of moving ahead in that field at their own optimum pace. This can be done even in the years of predominantly "general" education with intellectual satisfaction too seldom experienced by American schoolboys and undergraduates.

3. Provisions are made for doing the traditional eight years of school and college in seven years by superior students of good emotional stability, health, and social adjustment.*

The Program for Early Admission to College

This program was initiated in 1951 under the title, now abandoned, of "Pre-Induction Scholarship Plan." The basic assumption of the program is that there are a considerable number of young people who, though they have not completed high schools, are nevertheless competent to undertake work of college level successfully without jeopardy to their proper social and emotional growth. About 400 such students were admitted in September 1951 to 12 different colleges. Another 400 were admitted in September 1952.

It will probably require several years to make an adequate appraisal of the findings. However, some data has been made public for the first group:

1. The standards of selection used by the different colleges varied greatly. Most of the colleges used the C.E.E.B. or the A.C.E. tests, together with other factors such as high school reports and certain other criteria unique to the different colleges.
2. In age, they ranged from 14½ years to 16½ years. More than 50 per cent were between 16 and 16½ years of age.
3. 149 had completed 2 to 2½ years of high school
   170 had completed 3 to 3½ years of high school
   37 had graduated from high school
4. Most of the 420 students came from urban communities. Their parents were mostly in the lower income brackets and with no more than a high school education themselves.
5. A disproportionately large number have indicated that they expect to enter a career in some branch of the natural sciences.

In college, these students were not segregated, either in dormitories or in classes. Nevertheless, they were marked men and women. Despite this, they all did well—even better in many respects than the regular student body. They liked the experience tremendously. The extent of emotional and social imbalance was, in general, no greater than among the more normal student body. Participation in extra-curriculum activities was above average.

* The complete study has just been published by Harvard University Press: *General Education in School and College,* Allan Blackmer.

The School and College Study of Admission with Advanced Standing

This program was conceived by Dr. Gordon K. Chalmers of Kenyon College and took shape in the spring of 1952. To quote from Dr. Chalmers, the study begins with four opinions or prejudices:

"1. For the bright student who is well taught, the American system wastes time.
2. The best place for a schoolboy is school.
3. The best teachers of 17-year-olds are as likely to be found in schools as in universities.
4. The increase of professions depending upon graduate work and the necessary extension of graduate training for doctors, engineers, scholars, scientists, lawyers, etc. puts increasing emphasis on efficient use of the years available for study."

Twelve colleges have joined in the program, asking themselves these questions: "What does it take to earn credit for the freshman year? Can we describe this in a fashion acceptable to the 12 sovereign faculties? Can the studies so described and the other achievements defined be taught to exceptional students in secondary schools?"

Twelve high schools were invited to join the 12 colleges. The 24 heads of these institutions constitute the organizing and controlling group. Dr. William H. Cornog of the Central High School in Philadelphia is the Executive Director.

Eleven subject matter committees were appointed, each consisting of both college and high school people. They have been at work since last fall and hope to have their statements and definitions completed by the end of the school year. These courses will be introduced in a small number of the schools next fall and in a larger number in September 1954. It is still too early to say how many of the colleges will grant advanced credit for the successful completion of these courses or how success will be measured. The objective, of course, is to shorten the college course and to improve the quality of education in the years regarded as of such critical importance by the Ford Fund.

The Portland-Reed College Program

This is the fourth of the Ford programs, now in its very early stages; so that not much can be said of it. It involves a cooperative arrangement between the Portland, Oregon school system and Reed College. A group of gifted children will be identified for the purpose of enriching their school and college education. School and college faculties will interchange their locale for various purposes. Through a series of workshops the faculties are preparing themselves this year for the next stage of the program next fall.

Each of these studies is concerned with administrative and curricular adjustments for the top two to three per cent of ability levels. Also, they involve (in the main) atypical schools and school organizations. One or two of the studies, when first announced, drew sharp reactions from such professional groups as the National Association of Secondary School Principals. No matter what the findings and conclusions turn out to be, several significant questions will be raised:

1. How do present-day high school graduates, who complete the course in less than four years, compare with students in the four programs under review?
2. What point in ability-level is the critical point below which acceleration can not be safely attempted?
3. Are the changes called for by the studies administratively feasible?
4. What kind of teachers will be needed and what pupil-teaching load will they need to carry?
5. Will the findings be equally applicable to urban, suburban, and rural schools of varying size and educational facilities?
6. How can we increase opportunities for acceleration and enrichment for able youth in rural areas?

In view of the above, a fifth study is indicated; centered largely in the secondary schools as they are. Of the 26,000 high schools in the country, 75 per cent have fewer than 300 students; 15 per cent have fewer than 1000, 10 per cent have more than 1000. In the past 25 years, hundreds of thousands of able youth have been able to graduate from many types of high schools in fewer than four years. How have these schools and these students managed it? What administrative, curricular, teaching, and guidance procedures were employed? What have been the college, career, and life achievements of these individuals? How do they evaluate their experiences?

True, these students have all met the so-called requirements for a high school diploma and the specific degree requirements of the college. But, what does a high school diploma stand for? The variations from school to school, from state to state, are very great. Sixteen units of work are regarded as the standard minimum for high school graduation. In many schools, large numbers of students carry five periods of major work a day; so that they can accumulate fifteen of the units in three years.

Data on these questions is either available or can be gathered. There is a genuine need to study the relationship within chronological age and years of high school education, the achievement, the dropout, the professional futures, and the various aspects of adjustment (social, psychiatric, economic, and political) in view of certain background variants, such as intelligence, appraised personality, estimated interests, and anticipated major fields. Such data will provide an important frame of reference against which the current Ford studies can be checked. They can reveal the means, if means exist, for implementing the reorganization of education in grades 11 through 14. They can also reveal the kinds of approach which will enlist the cooperation of secondary school principals.

What Suggestions Can Be Made for Meeting the Special Needs of the Existing Critical Shortage of Scientists and Engineers?

The present critical shortage of scientists and engineers, the anticipated demands of a technological age, and the state of international tension emphasize the problem insofar as it relates to the early identification and special educational opportunities for potential scientists. What is the significance of early schooling on this special and much needed human resource? What success has there been during the first twelve years of a child's education, with the effort to discover, develop, and direct promising young people toward careers in science, broadly defined? There is need to study and evaluate the schools (and their many thousands of alumni) which have for years been using selection techniques, special curricula, and teaching methods for the education and guidance of future scientists.

We do not know if talent for science and mathematics is a measurable entity or if it is a function of general intelligence. It may be both or neither. Kindled interests or emphases in our present culture or vocational and professional opportunities may exert important influences. It would seem that a very large number of young people of top-level abilities find in science and mathematics, and early in their lives, an outlet for their interests and activities. We can not, we dare not be blind to the critical shortage of scientific and technical manpower. Civilization and our way of life are at stake.

Hence, any study of the effects of secondary and college education should include an intensive exploration of what happens to young people when special provisions have been made to discover abilities in science and mathematics and to nurture these abilities to the full. This can be done with complete recognition to high talent in other fields. To do so would indeed focus upon any imbalance, if it exists, and point to measures that must be taken if we are not to impoverish leadership in the humanities and in the area of human relations.

SELECTION AND TRAINING OF FUTURE SCIENTISTS, IV:

Developed Aptitude

IN SCIENCE AND MATHEMATICS

By PAUL F. BRANDWEIN

THERE IS GENERAL SANCTION to the belief that in considering the selection and training of scientists we are in a field highly carbonated with opinion. It is safe to say that in the attempt to reduce empiricism, or "cut and try" method, in this area, we are in at the beginning.

In this discussion, I should like to assume that the National Science Foundation is working immediately, and in large part, to redress the immediate shortage of scientific personnel, and that a shortage of scientific personnel may be a continuing problem of our society unless very basic measures are adopted; these basic measures are to be applied to the place *where the largest reservoir of personnel exists, at the secondary level.*

There is some assurance in being in at the beginning for as I had occasion to mention in another paper (1) we are on "relatively safe ground to begin with if we admit that we are operating in an ambiguous area, that an investigator may at least state his hypotheses to his own satisfaction provided they are not ambiguous to him and proceed to test them in light of clearly understood operations. As he learns more and more, his hypotheses and observations clarify themselves, one in counterpoint to the others. It may be assumed, however, that once the trait is operationally definable, and operationally observable, it may be possible to test it (that is, it may become operationally scorable)."

To what working hypothesis can a worker in this field safely repair? Which will yield him a respectable area of observation and experimental design? The limited working hypothesis which keeps me from straying from the firing line is this: High-level ability in science is a function of high general ability and cannot, at present, be isolated as a separate hereditary factor arbitrarily called, "science talent." Furthermore, young students with high achievement in verbal and mathematical skills can develop a high-level ability in science (a developed aptitude) if given appropriate opportunities (skilled teaching and wide training in laboratory science).

Developed aptitude is arbitrarily defined as, aptitude (or ability) which is based on training as shown by increase in knowledge and skills. I owe this definition to Frank Bowles, Director of the College Entrance Examination Board. What is meant by "opportunities" will be developed throughout this paper.

This hypothesis is based on continuing observations of some 400 students; 60 of these have already proceeded through high school, college, and post-college work, into research in science and productivity in other scientific areas. These observations are of many kinds. The most important are direct observation of the characteristics and behavior of these students over three years as they advanced through their studies in high school. Interview, questionnaires, and analysis of records were also used. Statistical analysis has also been made but we do not believe that a report of statistical evaluation of 60 cases in a field which has so many undefined variables is of value at this time. Hence this is a preliminary report similar to previous ones I have had the privilege of making (1, 2, 3).

What are the observations which support the limited working hypothesis stated here?

1. Observations on two entire freshmen classes numbering approximately 1340 students, in addition to the 400 special students mentioned above, indicates that under the present educational opportunities obtaining in Forest Hills High School the great majority of students who developed science aptitude, or high-level ability in science, and whose science interests were sustained to the point where major training in science (i.e., of a vocational nature) is selected in college, are typically students with high I.Q., high verbal ability, and high mathematical ability (as measured by standard tests). This is not to imply that a number of students whose I.Q.'s are of the nature of 100, or slightly above, may not contribute to science. Indeed, they

do as technicians and workers of a similar nature. But original work in science, it is our observation, requires high I.Q., high verbal ability, and high mathematical ability. Hereafter these characteristics will be called high general ability. In fact students without these abilities, and I am purposely neglecting to set a lower limit at this time, tend to be filtered out as they take advanced science courses (physics, chemistry, and advanced science, an elementary research course to be described later) and advanced mathematics courses, particularly trigonometry, advanced algebra, and higher mathematics.

Clearly a necessary educational operation is indicated here—namely, to furnish opportunities for these high-level students who will contribute to science as experts, and equally interesting, although not as rigorous, opportunities for those who will, as citizens, collaborate with these experts. Such a program, as a group of devoted science teachers have developed it, has been described in previous papers (3, 4) and by Subarsky (5). Our grievous general error in science is to assume that all students are to be given the same opportunities in science. The opportunities and objectives for general education are not hostile to special education; equal opportunity need not mean uniformity of opportunity.

2. Observations on the group above indicates that a clear relationship cannot be established between developed aptitudes in science and a science interest expressed before the ninth grade. Whether the science or mathematics interest establishes itself as a developed aptitude in science depends on two presently identifiable characteristics: (a) the presence of high general ability, and (b) the nature of the opportunities offered to develop the aptitude.

In a previous paper (2) the notion was presented that interest in science in youngsters of pre-high school age is a generalized phenomenon; it is much the same as an interest in collecting bottle caps or pictures of baseball stars was in youngsters who were part of previous "culture patterns." Youngsters are immersed in the gadget-science of space ships and space cadets, rockets, hot-rods, trips to the moon; the world of science fiction and the world of science is a present and effective part of their environment. The difficulty of maintaining that interest rests with the schools; in general their formalized, dry programs often destroy the interest. Also there is some difficulty in distinguishing between a temporary and pervasive interest. Zim (6) and Mallinson (7) have made contributions in their studies of science interest but additional studies need be made to determine how the presence or absence of opportunities for the realization of science interests react on the stability of the interest. Possibly, attempts to organize valid and reliable tests of developed aptitude in science (now a project of the College Entrance Examination Board and the Educational Testing Service) may enable us to select youngsters early enough to indicate whether the interest is stable enough to result in early, yet advanced training in skills and aptitude.

One cruel experience which may indicate the relationship may be worth recounting. One year we had 74 students of high level ability who applied for honors work in science (3) at Forest Hills High School. Two classes, approximately equal in ability, were organized. One was given to a teacher who subsequently had to relinquish the program; the class was given to a substitute teacher. Out of 37 youngsters in his class, only 15 subsequently chose four years of science. In the "control" group, 33 out of 37 youngsters chose four years of science. Subsequent experience of different kinds, leads me to the notion that youngsters of high-level ability need the most competent care; they cannot be left to expediency but require a carefully devised program.

At the Forest Hills High School, we have developed a type of program which affords all youngsters with high level ability an opportunity to enter into concentrated work in science.

The program is based on these ideas and practices: (a) Just as youngsters gifted in art and music are given early opportunities, so those with major interest in science should likewise be given early opportunities. They have, shall we say, a passion for comprehending the regularities of nature just as the others have a passion for music or for art.

(b) After the freshman year of general science, youngsters with high-level general ability are given the opportunity to select a program of science and mathematics which runs through every year of high school.

(c) This program differs from the biology, chemistry, and physics offered to other students in several major ways. The type of science is highly enriched (for instance, college texts are used in biology); the youngsters plan their own schedules and curriculum with the teacher and thus accept the major responsibility for getting the knowledge and laboratory skills desired. The classroom is considered not a place for giving information, but as a place for discovering it, hence the teacher gives "no information"* except as it pertains to safety.

* "no information" literally means just that—the teacher limits himself to questions and to guidance (e.g. suggesting reading material, material for experiments, etc.)

After the middle of the tenth year, each student may choose "advanced science," a course which is reserved for the prosecution of individual projects in the laboratory for as long as the student wishes, usually for the two years remaining in his or her career. Each student has, in addition, the widest choice of a good number of co-curricular and extra-curricular activities, clubs, societies, etc. Observation of students who have had the opportunity to immerse themselves in four years of science, skillfully taught, four years of mathematics, 2 to 2½ years of highly original individual laboratory work, four years of English, four years of one language, three and one half years of social studies, music and art, and extracurricular activities, shows that many of them develop the aptitudes that are important in science.

It is not difficult to imagine that youngsters who have taken upon themselves the responsibility of digging out the basic information in science gain a measure of independence in their subsequent quest for such knowledge. In short, they develop the aptitude for library research. Similarly, it is not difficult to imagine that youngsters who work on an "original" problem* for some two years in a laboratory gain a measure of independence in their subsequent laboratory work. They learn to plan their work carefully; they learn to identify problems; they learn to stare at blank avenues of thought with confidence that a solution will be forthcoming given patient effort, more facts, more observations, and more imagination. In short, they develop the aptitude for laboratory work. A good number even develop a love for it and determine that this is their life work.

Studies of these students now being carried on indicate that this program, with all its realized faults, has great promise for stimulating students to enter science, for maintaining their interest, for developing those aptitudes and attitudes we label "scientific," for sustaining the interest and increasing the developed aptitude through college and graduate school. Since 1945 when this program was instituted at Forest Hills High School, some 400 students have availed themselves of the honor program described in a previous paper (3); some 60 of these have been through college. It is eminently clear that if the others show the same progress as these 60, then 90 percent of the students with high-level general ability who avail themselves of the opportunities at Forest Hills High School, develop the aptitudes necessary to contribute in one way or another to science research. Further study of these students will determine whether our program has validity; six years from now we shall be able to deal more realistically with the data.

3. If this general discussion makes sense, then it may also follow that there is no personnel or manpower shortage in science, but an "opportunity" shortage instead. The opportunity shortage stems, it seems to me, from two sources. One is that our high schools, the place where stimulation of those with high-level general ability should occur, need to take a good look at their science programs. Second, if Dr. Hollinshead's data (8), which show that about 40 per cent of the age group who possess top-quarter ability finish high school but do not go to college, is taken as seriously as it should, then we also need to take a good look at our methods of subsidizing high-level students, as well as our methods of selecting college students. We cannot, in short, squander this nation's high-level ability by failure to develop its aptitude, or failure to give those with developed aptitudes the opportunity to contribute.

It also follows that an operation needs to be developed to correct this situation. If I may be excused a certain presumption and brashness I should like to offer some naive suggestions for this operation.

(a) It is reasonable to assume that some organization like the American Association for the Advancement of Science—and I place emphasis on Advancement—should accept initial responsibility for bringing existing interested groups to discuss the advantage of immediate and intensive collaboration in solving existing problems.

The work of existing organizations and individuals needs coordination and direction. The advantages of teamwork are apparent. We need not satiate ourselves in trial and error. The problem of the "opportunity" shortage is sufficiently distressing to merit the same attack we give scientific problems which require teamwork.

(b) After a wide and fully detailed program has been developed, foundations and/or governmental agencies may be interested sufficiently to finance the program. It cannot be denied that, at present, there exist individuals and groups who know a good deal about generating interest in science, about selecting students with high-level ability, and to afford them opportunities to develop aptitudes in science. I refer by way of example to the good amount of data and experience which resides in such schools as the Bronx High School of Science, in the work of the Office of Human Resources and Development, in the Westinghouse Science Talent Search, and in individuals and groups affiliated with

* "original" in the sense that no solution is readily available in the ordinary literature.

the National Science Teachers Association. Isn't it time we stopped talking about "manpower" shortages? It is my guess that one-tenth percent of the income of industry which stems from scientific development, and is at the mercy of the "opportunity" shortage now existing, would if applied to concentrated work on the problem show the way to practical solutions. I propose that the long-term solution in great part lies primarily in the secondary schools, and secondarily in the colleges.

(c) It is further proposed that the problem is not so much in selecting individuals with high ability but in making opportunities for their development available. We need to act on the supposition that there are already a number of teachers in our schools who can offer opportunities to youngsters with high general ability. We need also assume that they need to know through direct contact how others have solved the problem.

It is clearly indicated that the "operation opportunity" proposed here may proceed along many lines: research to discover the nature of high-level ability in science; research to discover how best to develop aptitudes in science; practical methods of discovering youngsters with the most successfully developed aptitude; and practical methods of transmitting to teachers the best practices in the field. It is strongly urged that there be mounted a co-operative attack on all aspects of the problem. In the United States we have the abilities, and if we wish, the facilities, to solve the problem of the "opportunity" shortage in science.

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Educationally WHAT DOES INDUSTRY NEED?

By SAMUEL W. BLOOM

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OUR INDUSTRIAL DEMOCRACY has again and again demonstrated the need for manpower highly skilled in the technical sciences of physics, mathematics, chemistry, biology, and engineering. To meet this need, emphasis has been placed primarily upon narrow specialization. Witness the many Ph D's in these fields. Industry and research need these specialists in increasing numbers. However, more and more, they also need scientists with leadership qualifications, men with rich backgrounds of training and experience. This type of leadership is sadly lacking in our currently trained men.

Some of the nation's largest research and industrial organizations have shown an unusual unanimity of opinion regarding the need for developing such scientific personnel. Their viewpoints are important for their educational implications. In most instances, the following expressions of opinion are those of the directors of research speaking as individuals.

Company I. (Electrical Products)

Ph D's are selected for employment according to their fields of work. However, the company is not interested in narrow specialists. Good, sound, fundamental training in the sciences and the scientific method is required. Men are wanted who have creative imagination and the proper scientific approach along with flexibility and a versatile background of experience.

Company II. (Steel)

This research director felt that the specialists turned out by the colleges today are well trained scientifically but are short on administrative ability. He cited the fact that eight out of ten cannot write a good, well-composed business letter. If they are to get ahead in his organization, they must have excellent command of English, both oral and written.

Men are preferred with extrovert characteristics who are able to get along with people. A primary

consideration always is how the newcomer will adjust to the existing staff.

Company III. (Technical Research)

This director summed up his chief criticism of many research men with the exclamation, "For God's sake, English!" He felt that the greatest weakness of some men in scientific pursuits is the inability to use the English language properly. He has noted that many research scientists are unable to write a clear, concise report of their findings. This necessitates increased supervisory assistance.

In addition to more than a perfunctory working knowledge of English, he emphasized that a basic understanding of psychology is important. Individuals should "have a reasonable working knowledge of how to get along with their fellow men." In a field dominated by rugged individualism, this ability for team work is urgently desirable.

Company IV. (Chemical Research)

This concern is most interested in the ability of their personnel to be able to put IDEAS ON PAPER and to be able to express and defend these ideas orally. Good English usage is demanded first and foremost. An illustration was given describing a brilliant Ph D on their staff who was not upgraded because he could not "sell" his research.

Another factor especially considered is the personality of the individual. Will the individual fit into the organization? Does he have scientific imagination? Is he creative? Will he insist on quality?

Company V. (Rubber Research)

This company considers specialized training as a primary requirement. In addition, they want men who are creative scientists, who have ideas and are able to carry them out with a minimum of direction.

A lack of proper training is found in:

1. Ability to write well
2. Ability to express oneself adequately
   a. Help is required to get ideas organized
   b. Too much of the supervisor's time is taken

Men who are thus handicapped cannot advance rapidly.

This company prefers scientists with a varied background in the educational field.

Company VI. (Chemical Products)

This corporation prefers research men who have a well balanced liberal arts background. "We want our people to be well educated and have a good command of English with the ability to express themselves succinctly." Of course, they have to be well-trained, also, in the special field for which they are hired.

Company VII. (Motors)

College personnel that they hire are technically well qualified but reveal such deficiencies as:

1. Lack of ability to see oneself in relationship to total job.
2. Lacking in preciseness.
3. Getting greatest skill of engineering into focus.
4. Relationship and meaning of engineering towards total organization.
5. Sadly deficient in English and ability to put reports on paper in understanding terms.
6. Unwilling to remain with basic routine jobs until they "get their feet on the ground."
7. Interpersonal relationships.

Educational Implications:

1. There is a need for increased, broad training in the fundamentals of science in preference to narrow specialization.
2. There is a need for better training in English and English usage.
3. There is a need for a basic understanding of psychology and for training in the art of getting along with others.
4. There is a need for a knowledge of cultural values inherent in fields other than science.
5. There is a need for a knowledge and appreciation of the social world as represented by more than a casual study of the social sciences.
6. There is a need for the appreciation of quality in whatsoever the field of endeavor.

Apart from a general recognition of the need for greater numbers in the many fields of science, there is a realization of the necessity for a greater diversity and flexibility in the training of our scientific personnel. Both pre-war and post-war curricula have been too narrow to produce the versatile individual needed to assume the administrative post demanded of the man trained in science.

In the planning of professional courses, greater attention should be paid not only to developing technical knowledge and skills, but also to recognizing the needs of a broader background of general education. Research organizations expect educational institutions to properly prepare their future administrators and executives.

LABORATORY MANUALS AND WORKBOOKS

IN HIGH SCHOOL SCIENCE

By FREDERICK B. EISEMAN, JR.

> More from St. Louis—this time a carry-over from the "teacher side" of the symposium on science text and reference books. When the March issue of *TST* appeared, we received several inquiries, "Where is Eiseman's paper?" Well, we just didn't have space for *all* the teachers' papers in that issue and felt that Fred's would be a good bridge into the publisher half of the symposium.
>
> Mr. Eiseman's training and experience have been somewhat unusual. He is now teaching chemistry in the John Burroughs School, Clayton, Missouri. Following collegiate training in chemical engineering leading to a B.S. and an M.S. degree and brief but successful experiences in the world of business and industry, he still felt a desire for another kind of career. Went back to school at Columbia University's Teachers College and worked out a Master's degree in education. He served on the general committee that guided production of the Bulletin on "Science in Secondary Schools Today."

MANY PEOPLE FEEL that the less said about the laboratory manual and workbook the better. Herbert Zim, in his NSTA Ann Arbor speech last summer, made some such statement. I suppose that this was intended to be an example of damning with faint praise, and I am in total accord with Mr. Zim. However, I do not agree that the less said the better. If we have a situation with which we are not satisfied, it seems to me the more said the better. Perhaps then the publishers and authors will take note and remedy the difficulty.

I do not think that many science teachers will debate the potential value of individual laboratory work. No other aspect of the modern course in high school science provides such an excellent opportunity for the development of critical thinking, development of skill in manipulation, and the supplementing of the textbook as a source of information. Some teachers may not realize that there is another equally important value in science laboratory work. Writing up laboratory exercises gives the student an excellent chance to practice the skills of exact expression. All four of these goals, exact expression, skill in manipulation, supplementary information, and skill in problem solving, are potentially valid ones.

Many teachers, however, do not bridge the gap between the potential and the actual. They feel that just devoting three or four periods a week to laboratory work will automatically inculcate upon their students the potential advantages to be gained. Actually, three or four periods a week can be of extreme value to high school science students in the laboratory. However, many of us invalidate this time by providing improper written materials for their use. Many science teachers devote a good deal of time to choosing a textbook, and then pick anything at all for a laboratory manual, even though laboratory work occupies one-third of class time.

Most high school teachers have accepted the workbook or laboratory manual as the laboratory guide or text. Most of these manuals are not educationally sound. Let me give you a few examples. My examples will be from my own field of chemistry, but they are probably equally applicable to physics and general science manuals.

An examination of ten currently popular manuals in high school chemistry reveals the fact that only two of these ten are designed to foster the development of the desirable phases of laboratory work. The other eight not only do not encourage the development of these skills, but rather positively discourage it and detract from its development.

To be specific, a study of these manuals reveals at least eight serious defects.

1. In almost every case, the student is not required to write more than a word or phrase here and there. This certainly does not develop skill and ability in exact expression, a desirable attribute of a scientist. A child may not even be able to write an intelligent English sentence and still pass the laboratory work with flying colors. In addition to the fact that filling-in the blanks is an unrealistic

approach to a real problem, it makes the adjustment to the long and more difficult college experiment report that much more difficult.

2. The attention of the student is directed toward those observations that the author wants him to make. Instead of being left to his own resources to make detailed observations, as would be the case in a real experiment, he is told merely to record whether or not a precipitate is formed, or whether a gas is evolved. Indeed, he is often prevented from recording other observations because of the lack of space provided. This is certainly not a device calculated to foster development of scientific methods of problem solving.

3. The experiments offered do not follow any organized pattern. They consist of a hodgepodge of blanks, directions, and pictures. No concept of an orderly approach to problem solving is conveyed.

4. Most of the directions listed either directly or indirectly imply the answers to the questions asked. It is quite obvious to the student reading the question just what word or phrase the author wants placed in the blank. For example, a currently popular laboratory manual describes in some detail the brown ring test for the nitrate ion. It includes a picture of the test tube, containing all the requisite substances, showing the brown ring and all other materials appropriately labeled. Then, after directing the student to add the same substances that the sketch shows, the question is asked:

> "Does a brown ring appear in the test tube? ...."

And the next question is:

> "Describe it ...."

This is a double answer implication. The picture implies that a brown ring will form and furnishes a direct answer to the second question. The second question directly implies that the answer to the first question is in the affirmative.

As a matter of fact, the whole idea of asking Yes-No questions is basically unsound. The student has a 50-50 chance of getting the answer right without knowing anything at all about the question, and his odds are usually substantially increased by the textual material hinting at the desired results. A good example is this question, taken from a recent manual:

> "Does hydrogen burn? ....
> What substance is formed when hydrogen burns? ...."

5. In many cases, the desired answer to the blank is suggested by listing two or three alternatives after the blank, so that the student does not even have to think of a single word. For example, a manual reads:

> "Carbon dioxide's solubility in water is ....
> (poor, fair, good)."

None of these practices encourages critical thinking, or, for that matter, any thinking at all.

6. Many laboratory manuals do not require the student to write equations. Even in the latter parts of the manuals, when the student presumably is familiar with chemical equations and formulas, all that is required is the completion of an equation that has already been started by filling in one or two formulas.

7. The mathematical treatment of the quantitative experiments is in the same cook-book form as the qualitative part. For example, in the standard experiment for the determination of the equivalent weight of magnesium by reaction with an acid and collection and measurement of the hydrogen produced, the entire mathematical formulation was printed right in the manual. All the student had to do was substitute in the printed equation the two or three measurements he had made and grind out the answer, without having to make any effort at all to understand what he had done.

8. Since most of the laboratory manual experiments are designed to be written up on the same sheet on which the directions are given, the student is not required to sketch the equipment used. This practice is often considered desirable in order to fix in mind the apparatus of the experiment.

In summary, then, it may be said that the majority of currently used laboratory manuals tend to discourage rather than encourage the desirable outcomes of laboratory work. It is true that the students may enjoy the manipulating, even though it is essentially meaningless to them. However, when they know in advance what they are expected to discover, the zest is taken out of their work, and many familiar unscientific practices are bound to result.

What has been the cause for this trend in laboratory manuals? It is felt that the principal blame should be laid upon the teachers. If we did not want or use such books, authors would not write them and publishers would not publish them.

Why should teachers want these cook-book type manuals? The average science teacher probably finds himself on the horns of a dilemma. He may realize that the current crop of manuals is poor and unscientifically planned. However, he also realizes that his time is severely limited. The laboratory manual form is designed to be written up briefly

(Please continue on page 139)

PROBLEMS OF PUBLISHING SCHOOL SCIENCE BOOKS

By ARLEIGH HOUGH

And still more from the St. Louis meeting! Here is an airing of some of the problems faced by publishers in providing the science text and reference books that teachers want and need.

Interested in general problems of the publishing business? Read Arleigh Hough's article; he is managing editor of Rand McNally & Company, Chicago. For a glimpse of the financial problems of publishers, read MacLean Johnson's discussion. Mr. Johnson is vice-president of the Webster Publishing Company in St. Louis. Mr. Wareham, head of the science department of D. C. Heath, Boston, gives manuscript suggestions in his article that many science teachers (and their English teacher colleagues, too) will want to use on their own students.

We know for a fact that if any of these articles generates a strong reaction on your part, the author will appreciate hearing of your agreement or disagreement.

THE WORDING of the assigned topic is gratifying and reassuring. I am conscious of many problems in publishing school science books. I am not sure that I know the answers. The wording of the topic seems to justify a discussion of these problems without attempting to provide solutions. The problems are many and of varied character. Your panel members have attempted to classify the problems and discuss special fields accordingly. My own assignment is "Selection of Content." But there is a considerable overlapping among these various fields. In a similar situation a lady said: "I'm concerned that I may repeat what someone else will say later." I share that concern.

Since school science books are published for all grade levels and since problems of content selection at the various levels are somewhat different, these different problems will be presented for the various levels separately.

PUBLISHING PROBLEMS IN ELEMENTARY SCIENCE

1. How can the elementary-science program be made a part of a complete and carefully planned science-education program for grades one to twelve, inclusive?

   a. How can undesirable duplication of materials at different levels be avoided?

   b. How can concepts be gradually developed so that each year's work is a preparation for the next?

2. How can presentation of concepts beyond the comprehension of children at different levels be avoided?

3. To what extent should the vocabulary of science be limited to insure reading ease? That is, to what extent can the use of scientific vocabulary be limited in order to make the science course less frustrating to the pupil?

4. What accessory materials are an essential part of a publisher's science program for the elementary grades? Manuals? Charts? Kits of simple laboratory equipment? Film strips? Movies? Other audio-visual materials?

5. To what extent should an activity program be incorporated in a science textbook? What should be the character of that activity program?

6. Are artists' drawings or actual photographs more desirable in a science text? Granting that both types of illustrations are sometimes desirable, what are the special situations in which one type is more desirable than the other?

PROBLEMS IN PUBLISHING GENERAL SCIENCE BOOKS

Inasmuch as time will not permit any considerable discussion of problems at all levels, it may be useful to concentrate at one level. Because general-science content is derived from the various other fields, perhaps fuller discussion in that area will be most significant. At any rate, it seems certain that the selection of content at the general-science level is far from the field of general agreement.

The power of tradition

Quite a long time ago Dr. Harold Benjamin released to an amused and amazed public the "Sabretooth Curriculum," a delightful "study" of the uni-

(Please continue on page 140)

THE FINANCIAL SIDE OF TEXTBOOK PUBLISHING

By W. MACLEAN JOHNSON

WHETHER OR NOT you will have an abundant selection of materials to teach biology, or any of the other sciences, is an issue more likely to be decided in the meetings of local Boards of Education and in the committee hearings of state legislatures than it is in the editorial rooms of America's educational publishing houses. Both the variety and the quality of the instructional materials to become available to you depends in the end on school finance. Your subject, your enrollment, and especially your school budget for instructional supplies are all forces influencing the educational publisher's output.

The 1952 edition of Bowker's Educational Catalog lists twenty-five biology and seventeen physics textboks. Considering the forces that are in motion today, you may reasonably expect a continued good supply of both texts and supplementary aids for teaching biology; possibly fewer rather than more texts to choose from to teach physics. Here are the factors that affect publishers' decisions:

1. The percentage of students enrolled in high school biology has been steadily increasing from 1922 to the present (8.8 per cent in 1922 and 18.4 per cent in 1949).
2. The percentage of high school students enrolled in physics has declined slightly in the same period (from 8.9 per cent to 5.4 per cent).
3. The publisher must invest *twice as much money* today as he would have invested in 1939 in typesetting, engraving, artwork, electrotypes, and editorial salaries in order to publish the same book.
4. Schools have, in general, been spending fewer stable dollars (money with the inflation factor removed) per child since 1946.

Before a publisher can print one single copy of any textbook, he has to spend money—lots of it—to get plates to put on the printing press. The

(Please continue on page 142)

THE PREPARATION OF SCHOOL SCIENCE TEXTBOOK MANUSCRIPTS

By RICHARD T. WAREHAM

BY this time it is obvious to all of you that the profitable publication of school science textbooks is not a simple matter in these times. If you had not known it before, you are now aware that the business is highly competitive, and that a publisher cannot hope even to get his investment back, let alone make a profit, on the big beautifully, often colorfully illustrated, and costly textbooks now offered for adoption, unless his sales are large. A publisher therefore cannot afford to risk investment in a mediocre book; and all publishers are constantly hunting for people who can write a better book or series of books than any of those now on the market.

We agree that none of the current books are perfect teaching tools. Probably the perfect book is only an ideal, never to be realized, for a textbook is the result of a series of compromises. The publisher and author must see to it that the book satisfies to a large extent dozens of varying courses of study, or their market automatically becomes disastrously limited. The resulting compromises—too large a book for anyone, not enough of the right material for everyone, poorer quality than desirable because of the larger size. This is not a complaint. The situation is unavoidable. The only way to avoid the omnibus books would be by nationally decreed, uniform courses of study, and since in that solution lies the way to stagnation, I would have none of it.

I mention these things because the author every publisher is looking for must know these facts. The author must be prepared to sublimate his own hobby, his own specialty, in order to make space for subject matter others are interested in teaching. He must know the courses of study prepared for all the large adopting units and see that the principal topics of all these courses of study are included in his manuscript. One aspect of manuscript preparation then is related to content—already the subject

(Please continue on page 143)

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NSTA Activities

Nominees Nominees For 1953-54 Reported By Committee

On pages 122-124 is a list of nominees, together with biographical sketches, for officers and directors of NSTA for the ensuing year.

In line with expressions of sentiment by the Board of Directors at the Mills College meeting in 1951 and with practices followed by other NSTA nominating committees, this year's committee is offering a slate of one candidate for each office except directors-at-large where twice the number to be elected have been nominated. These nominees have been selected through the following procedures: (1) suggestions received from members of NSTA (requested in the November issue of *TST*, page 294); (2) suggestions received from officers of affiliated groups; (3) suggestions received from present officers and directors of NSTA; (4) exchanges of correspondence and judgments among members of the nominating committee relative to the more than one hundred persons suggested in procedures 1-3.

Ballots will be distributed by mail to all Association members. Every member of the Association is urged to vote.

The nominating committee is comprised of Mr. W. Bayard Buckham, Oakland, California; Mrs. Marjorie H. Campbell, Washington, D. C.; Dr. Ira C. Davis, Madison, Wisconsin; Dr. Hubert M. Evans, New York City; Dr. Clyde T. Reed, Tampa, Florida; and Louise E. Lyons, Steubenville, Ohio, *Chairman*.

Statistics Of Pittsburgh Convention

The First National Convention of NSTA is now history. And history was indeed made at Pittsburgh. Total registration reached 617, representing 33 States from coast to coast. Over 400 persons attended the Pittsburgh Hospitality Night on Thursday and 306 sat down to dinner at the banquet session on Friday. The thirty commercial exhibits were well attended as were the nearly twenty instructional exhibits. None of the nineteen discussion groups had to be canceled for lack of participants and four had to be moved to larger rooms because of overflow crowds. A concern of the 1954 Convention Committee is: How can we come up with a set of major addresses to equal those of the Pittsburgh meeting? All reports of the convention sessions and discussion groups are now in the hands of the Publications Committee (Herbert S. Zim, *chairman*) and the published report of proceedings is expected to be ready for distribution by May 1. Many who were unable to get to Pittsburgh will want a copy of this report. The price will be $1.00.

Miami Beach Meeting To Be Held June 27-29

The 1953 Annual Business Meeting of the NSTA Board of Directors and a follow-up professional conference for science teachers will again be held in conjunction with the summer meeting of the NEA Representative Assembly. All NSTA sessions will be held in the Delano Hotel, Miami Beach, Florida. Major program items are as follows:

June 27, 9:00-12:00 a.m. and 2:00-5:00 p.m.: Board of Directors meetings.

June 28, 9:00-12:00 a.m.: Board of Directors meeting.

June 28, 2:00-4:00 p.m.: General Session of Conference.
- "Welcome"; W. R. Thomas, Superintendent of Dade County Public Schools
- "Everyone Can Find Science in Public Parks"; I. D. MacVicar, Chairman, Dade County Board of Commissioners
- "Science Is Where You Find It"; Jay F. W. Pearson, President, University of Miami

June 28, 7:00 p.m.: Dinner Session of Conference
- "Conspiring to Inspire Through Science Teaching"; Dr. Woolford B. Baker, Professor of Biology, Emory University, Atlanta, Georgia

June 29, 8:00 a.m.-5:00 p.m.: All-day Field Trip.

Cost of trip including admissions, lunch, and transportation is $3.50. In the afternoon, Roy Woodbury of the University of Miami will address the group on "Flora Found in Fairchild Gardens."

The committee in charge of arrangements for the professional conference includes: *chairman,* Leo L. Boles, Little River School, Miami; N. Eldred Bingham, University of Florida, Gainesville; Robert A. Burton, Miami Technical High School; Clyde T. Reed, University of Tam[illegible] F. G. Walton Smith, Marine Laboratory of the Univer[illegible]ty of Miami; and James Wanza, Booker T. Washington High School, Miami.

NSTA members and other science teachers planning to attend the conference probably will wish to make hotel reservations in advance. Write to: NEA Housing Bureau, Box 1511, Miami Beach, Florida.

Presenting—NOMINEES FOR OFFICERS A

WALTER S. LAPP. ***President-elect.*** Head of science department, Overbrook High School, Philadelphia, Pennsylvania. AB, AM, PhD (chemistry), University of Pennsylvania; research on 2,4-D and other herbicides, consultant on turf and weed problems, patent on Rollosprayer (a vehicular spraying machine), numerous articles on turf, weeds, and science education. Vice-president and membership chairman NSTA 1948-50, NSTA delegate to American Chemical Society Diamond Jubilee 1951; member production committee for Pennsylvania State Course of Study in Science (Bulletin 400) 1951, President Pennsylvania Academy of Science 1951-52. Married Myrtle D. Snyder in 1920; two children—Walter and Mary Jane; gardening, photography, and travel.

ZACHARIAH SUBARSKY. ***Secretary.*** Chairman, Department of Biology and General Science, High School of Science, New York City. BS, City College of New York, MS, PhD, Columbia University: "What Is Science Talent?", *Scientific Monthly,* "Atomic Energy For Good," *The Science Teacher,* "Vocational Guidance Through Biology Teaching," *Education;* Fellow, American Association for the Advancement of Science. Member Advisory Council on Industry-Science Teaching Relations 1948-51; Secretary NSTA 1952-53; Past President Federation of Science Teacher Associations of New York City. Married, two daughters ages 7 and 10; violinist, ornithology.

JOHN S. RICHARDSON. ***Treasurer.*** Associate Professor of Education, Ohio State University. BS in Ed, Miami (Ohio) University, MA, PhD, Ohio State University; co-author *Methods and Materials for Teaching General and Physical Science* (McGraw-Hill) "College Facilities for Science Teacher Education," *The American School and University,* and others; Phi Beta Kappa; Phi Delta Kappa. Editor NSTA research study of *School Facilities for Science Instruction,* chairman Advisory Council on Industry-Science Teaching Relations 1952-53. Wife Helen, three children—Alan (12), Neil (9), Lynne (4); woodworking, travel, reading "who-dun-it's."

ELRA M. PALMER. ***Eastern Regional Vice-President.*** Supervisor of science, high schools, Baltimore, Maryland. BS, MEd, Johns Hopkins University; numerous articles in *Baltimore Bulletin of Education, The Maryland Naturalist, The Maryland Conservationist, The Baltimore Sun;* Phi Delta Kappa. Eastern regional director NSTA 1950-52, Packet Service evaluator; trustee Maryland Academy of Sciences; President Maryland Biology Teachers Association. Married, two children—Genevieve (10) and Arlene (3); stamp collecting, geology and paleontology of Maryland, president of residential community association.

STANLEY E. WILLIAMSON. ***Western Regional Vice-President.*** Head of Department of Science Education and Director of Student Teaching, Oregon State College. BA, Nebraska Wesleyan University, MA, Columbia University, EdD (nearing completion), University of Oregon; Phi Delta Kappa; several articles on science and education in University of Oregon Bulletins. NSTA state director for Oregon six years, member NSTA Board of Directors 1949-52, chairman NSTA workshop committee on Science Education in Civil Defense; member Oregon State Advisory Committee on Teacher Education and Certification; Director Northwest Regional Institute for Science Teachers four years. Wife, Berdeen, and three children—Brian (14), Richard (10), and Cinda (5); photography and family camping trips.

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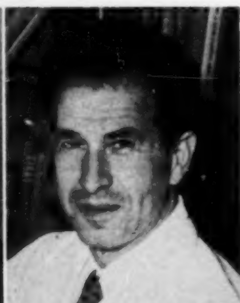

JOHN S. RICHARDSON

ELRA PALMER

STANLEY E. WILLIAMSON

HELEN E. HALE

RS AND DIRECTORS FOR 1953-54

The following biographical sketches include, in this order: name; position for which nominated; present professional connection; degrees, publications, and special honors; NSTA and other professional activities; family and hobby interests. See also "NSTA Activities," page 000 of this issue of *TST*.

HELEN E. HALE. ***Eastern Regional Director.*** Secondary School Supervisor, Science and Mathematics, Baltimore (Maryland) County Schools. AB, Goucher College, MA, Johns Hopkins University, graduate work in physics and education, Cornell University; contributor to "Physical Science Today," *The Science Teacher,* several bulletins on science curriculums, bibliographies, and workshops in science and mathematics; Pi Lambda Theta. Member NSTA research study committee on *School Facilities for Science Instruction;* photography, gardening, and "nieces and nephews."

JOHN G. READ. ***Eastern Regional Director.*** Professor of Education, Boston University, BS, University of Massachusetts, MA, Brown University, EdD, Boston University; *Read General Science Test* (World Book Company), numerous articles in *Science Education, The Science Teacher,* and others. Member NSTA Film Excerpt Committee, Committee on Laboratory Apparatus and Equipment; member executive committee Science Teachers of New England, chairman Science Teacher Awards committee American Academy of Arts and Sciences. Married, son (science editor with Ginn and Company), daughter (married, first-grade teacher); rug-hookery.

H. M. LOUDERBACK. ***Western Regional Director.*** Chemistry instructor, Lewis and Clark High School, Spokane, Washington. AB (biology), Whitman College, MS (chemistry), Washington State College; "Partial Molal Volumes of Nickel Sulfate Solutions," *Journal of the American Chemical Society;* Fellow 1951 summer conference for science teachers, Massachusetts Institute of Technology; program chairman Science Section of Inland Empire Education Association, 1953-54. NSTA Packet Service evaluator; member of committee for Greater Spokane Science Fair. Married, three children; officiating football and basketball.

ROBERT STOLLBERG. ***Western Regional Director.*** Associate Professor of Education, San Francisco State College. BS, BEd, Toledo University, MA, EdD, Columbia University; dozens of articles concerning science, electronics, and science education in several different journals. Chairman of committee for "Science in Secondary Schools Today" issue of *The Bulletin* of National Association of Secondary School Principals, member NSTA committee on certification of science teachers; chairman of steering committee for Elementary School Science Association of Northern California. Married, three children; photography, music, electronics; active in Naval Reserve.

GLENN O. BLOUGH. ***Director-at-large.*** Specialist for Elementary Science, U. S. Office of Education, Washington, D. C. AB, AM, University of Michigan, graduate work at Columbia University and University of Chicago, LLD, Central Michigan College of Education; *Elementary Science and How to Teach It* and *Methods and Activities in Elementary Science* (Dryden Press), co-author *Discovering Our World* books for inter-

(Please continue on next page)

HALE — JOHN G. READ (BOSTON UNIVERSITY PHOTO SERVICE) — H. M. LOUDERBACK — ROBERT STOLLBERG — GLENN O. BLOUGH (FABIAN BACHRACH) — WAYNE TAYLOR — MAURICE WHITTEN (GAYNOR STUDIO)

mediate grades (Scott, Foresman and Company), twelve primary-grade science books, and many articles in professional journals. Member NSTA Board of Directors 1947-50, chairman Elementary Science Committee 1951-53; member editorial board *World Book Encyclopedia* and *My Weekly Reader*.

ROBERT MOLKENBUR. ***Director-at-large.*** Chemistry instructor, Central High School, St. Paul, Minnesota. BA, Macalester College, MA, University of Minnesota; articles published in Journal of the Minnesota Education Association and proceedings of the Minnesota Academy of Science. NSTA State Director for Minnesota, member committee on affiliated groups, Packet Service evaluator; past-president Minnesota Junior Academy of Science and Physical Science Section of Minnesota Education Association. Married, three children—James, Mary, John; works summers for Minnesota Mining Company.

WAYNE TAYLOR. ***Director-at-large.*** Head, science department, Denton High School and Director, Travelling Workshop, Texas State College for Women. BS, MS, North Texas State College, postgraduate work at Columbia University and Massachusetts Institute of Technology; Phi Delta Kappa; Fellow American Association for the Advancement of Science, second place award for college campus programs of Freedoms Foundation 1952; "The Use of Industrial and Technological Resources in Teaching," *The Science Teacher*. Packet Service evaluator, member NSTA committees on laboratory apparatus and equipment and professional relations and projects; president-elect AAAS Academy Conference, president Texas Science Teachers Association. Married, one son; amateur radio operator, photography.

MAURICE M. WHITTEN. ***Director-at-large.*** Head of science department Lewiston (Maine) High School. AB, Colby College, MA, Columbia University; General Electric Fellow, Union College, 1946, participant in First National Thomas A. Edison Foundation Institute for Science Teachers, 1951. NSTA state director for Maine since 1950; chairman Science Department of Maine Teachers Association 1949 and 1953; served on several committees of New England Association of Chemistry Teachers. Travel; summer work—blueberry inspector for State of Maine; active in radiological defense section of Civil Defense program.

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Indianapolis Telecasts Science Achievement Awards Program

EDITOR'S NOTE. This is one of the few items to be reprinted in *The Science Teacher* following prior publication elsewhere. However, we have three reasons for doing so: (1) NSTA members will be interested in the publicity that Association efforts have received in the *Metals Review* (February, 1953) which is published by the American Society for Metals; (2) this will be a reminder to all that entries for this year's Science Achievement Awards contest should be sent to regional chairmen soon since May 31 is the closing date; (3) it may suggest publicity possibilities and ideas to winners in this year's contest as plans are made for the presentation of awards next Fall.

A SHORT time ago the Indianapolis Chapter promoted the National Science Achievement Awards through an Indianapolis telecast.

The telecast was held in conjunction with Gilbert Forbes News Telecast. The individuals involved, in addition to Mr. Forbes, were Carl O. Sundberg, our chairman, Hugh A. Townsend, State Director, N.S.T.A. (National Science Teachers Association), and our local winner Thomas Steele. The script which was used on the telecast program is printed below.

FORBES—We have with us tonight a young man, a student of Howe High School, who has recently won a National Science Award, and two gentlemen who will explain the purpose of this award.

The National Science Teachers Association conducts this award and Hugh A. Townsend, Indiana state director and science instructor at McKinly Junior High School, Muncie, Ind., is present and will tell us the part his organization plays in this award. First, Mr. Townsend, will you explain the purpose of N.S.T.A. and this award.

TOWNSEND—N.S.T.A. is the National Science Teachers Association. It is a department of National Education Association, commonly known as N.E.A. N.S.T.A. is interested in better science education of our youth and promotes projects and services which I would like to tell you about. Since our time is limited, I will mention just the National Science Awards program for students and teachers. Its purpose is as follows:

First, to stimulate interest and encourage individual and small group experimentation and projects in science by junior and senior high schools on a very broad base in grades 7 through 12.

Second, to encourage higher regard for good science teaching in the schools by providing awards to those schools represented by student award winners.

Third, to recognize and reward science teachers who report outstanding efforts and effective techniques directed toward stimulating increased interest and activity in science among their students.

FORBES—How is this award conducted and sponsored?

TOWNSEND—N.S.T.A. judges the papers submitted by the students and teachers. The American Society for Metals sponsors the awards.

FORBES—Mr. Sundberg, why is your organization deeply concerned in the sponsorship of scientific thinking among students?

SUNDBERG—Mr. Forbes, the American Society for Metals is the engineering society of the metals industry and this industry is the largest employer of all types of engineers and scientists. There is a definite shortage of trained personnel. Industry can easily absorb 50,000 engineers a year, and this year only 27,000 will graduate. By contrast, Russia reportedly is graduating 100,000 engineers per year.

Therefore, the American Society for Metals is actively encouraging students to think about and prepare for their future. The sponsorship of this awards program is one of several steps taken by our society to increase the number of trained people for research, engineering, teaching, and technical work.

FORBES—Certainly there are plenty of opportunities for the young men and women of today in industry and science; also an excellent opportunity to win awards while preparing for their future. Briefly, what is the extent of these awards?

SUNDBERG—A total of 124 awards will be presented in 1953 throughout the United States and Canada, 104 to students totaling $5000 in cash and defense bonds, and 20 to teachers totaling $1000 in cash.

FORBES—And now we are most happy to meet Thomas Steele who is 15 years of age and a junior at Howe High School here in Indianapolis. Tom has been honored for his work in biology by the N.S.T.A. and received a 1952 Science Achievement Award. Tom is a consistent honor roll student and a potential science major.

Tom, we in Indianapolis are very proud of you. Tell us about your project and what part it plays in science.

STEELE—Mr. Forbes, my paper was written on tissue culture which is continuing growth of living cells from animals in an artificial medium and observing their growth and behavior.

My procedure was to open an egg using sterile instruments and remove the thighbone from the living embryo which was two weeks old. I then put the thighbone in a glass dish containing a nutritional substance for the bone. The dish was placed in an incubator and carefully observed. The importance of tissue culture is the study of living cells in cancer research.

FORBES—Tom, I understand that your award was presented at a general assembly on Nov. 12. Tell us about this.

STEELE—Yes, my award was a $50 defense bond and Howe High School received $50 cash for the science department. I would like to encourage other students to pick a project and enter this contest since it provides a goal to work toward.

I also would like to thank my science teacher, Mr. Klinge, for his help and encouragement.

FORBES—I understand your teacher, Paul Klinge, won a Science Teachers Award. Is that correct, Mr. Townsend?

TOWNSEND—Yes, Mr. Forbes, Tom's teacher, Mr. Klinge, won a separate award for his special paper concerning teaching of science.

FORBES—Briefly, what must the student do to enter this coming year's contest?

TOWNSEND—First, start now on a project, investigation, or other special activity in some field of science or mathematics. Second, consult with your science teacher who is ready and able to assist you and has the official entry forms. Third, complete the entry form and send to the address shown.

We wish the best of luck to the entrants for next year.

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Turn About's Fair Play!

By ROBERT D. MacCURDY
Science Teacher, Watertown, Massachusetts
and His Student: C. RICHARD LEACY, Editor of "ABC," Senior High School, Watertown, Massachusetts

EDUCATORS POSED THIS QUESTION many years ago—"How can we make learning more interesting in order that our students may assimilate knowledge more quickly?". We all know the magnetism a job has if it is interesting, and the repulsion that same job has if it is boring. There must be some incentive to get the job done and done well.

Dr. John G. Read had a class of experienced science teachers in his course on "Teaching Science in Secondary Schools." He wanted to send them on a field trip to show them how some other science classes were being taught in the nearby locality. He talked about his idea to his pupil and summer school assistant, Mr. Robert D. MacCurdy. The Science Education Professor suggested to the Science Teacher that the latter's Science Students could show the visiting science teachers some of their projects if the science students could come to school on Saturday morning. The plan was approved by the high school Headmaster, Mr. Thomas A. Blake.

The Science Teacher turned for help to his number one assistant among his Science Students, C. Richard Leacy, Editor of the Associated Biology Club's newspaper, the "ABC." Together they worked out a scheme that almost fits the time-honored plan of a news item, "if a man bites a dog, it's news." It was to be a reversal of the normal routine. The visiting science teachers would be students for the day. They would be taught by the local Science Students who would be in the position of teachers. The course would be "Science Education Methods." The lessons would be a series of short demonstrations in three of the classrooms of the high school. There would be a schedule to follow, carefully planned demonstrations, and a summarization at the conclusion of the program.

Following is a copy of the letter of introduction that each visiting teacher received and a copy of the schedule he followed that morning.

November 15, 1952

"Dear Science Teacher:

You are about to witness a very unique event. You are about to see the process of teaching taken over by the students. One of the latest methods for teaching is to reverse the normal procedure and give the students a special project and allow them to get all the information they can on their particular topic. Then they can teach the rest of the students. In this way we achieve two accomplishments. First, the student teacher derives more knowledge than he would ordinarily about his subject. Second, those being taught realize the importance of the other person's project because each sees how it ties in with his particular project.

We have been working on a method to put this idea into practice. As the answer to our problem, we finally came upon the Travelling Teacherettes and the various other projects which you are soon to observe.

This is what the student gains from the experience. First, as stated above, the student gets more information about his particular subject than he would have if an adult teacher had taught it. Second, as a student himself, he realizes certain perplexities of his subject that may trouble those he is to teach and therefore can clarify these obstacles. Third, he is able to explain the subject in language which the average student can understand—something that I feel we ourselves are sometimes guilty of not doing. Fourth, he gains practice in public speaking, for he is continually before the public speaking to it. We all know how important it is to be able to speak before a group and express ourselves with clarity.

We hope that you will find this experience both enjoyable and profitable. Here is an instance where both student and teacher can gain knowledge from a reversing of normal order.

Cordially yours,

John G. Read
Professor of Education, Boston University

Robert D. MacCurdy
Instructor Summer Term, Boston University, and
Teacher of Biology, Watertown High School

C. Richard Leacy
Editor of The 'ABC'"

All proceeded on schedule and when most of the visiting science teachers had departed, the local staff of science students sat down for a luncheon and discussed in owlish wisdom the behavior and questions of the regular science teachers. The

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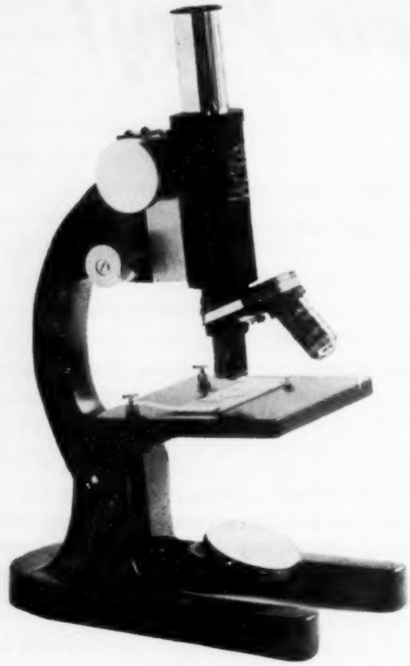

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students agreed that all showed promise and interest, and with some further development the regular teachers could perhaps become Master Teachers. They thought that teaching was a tiring but satisfactory experience; they would not mind doing it again.

A few days later the visiting science teachers met again with the Science Education Professor and discussed the experience. They agreed that the science students showed a high degree of co-operative behavior, were unusually bright, and suspected that the classes had been grouped homogenously. (This latter was not so.) They thought that activities like this would be helpful in uncovering scientific talent. Professor Read, Teacher MacCurdy, and Editor Leacy agreed that it was work but fun; all would like to do it again someday.

HOW ABOUT SUMMER SCHOOL along the North Carolina sea coast—making specimen collections, taking field trips both inland and on the water, seeing and hearing illustrated lectures? This experience can be yours through the "Summer School in Outdoor Sciences" to be conducted July 6-August 14 by the Division of College Extension of North Carolina State College. For further information write to the Division at Raleigh, N. C.

Schedule

Order	Subject	Student Teacher	Room	Time Allotted	Time
1.	How to Build and Maintain an Aquarium	Peter Chaplick	3	Free "get-acquainted" period.	9:00-9:15
2.	How to Build and Maintain a Terrarium	Richard Shapazian	3	" " "	9:00-9:15
3.	NSTA Science Achievement Awards Contest	August Schomburg	7	20 min.	9:15-9:35
4.	Biology Club	Aristides Cagos	3	5 min.	9:35-9:40
5.	Classroom Teaching Assistant—Anthropology	Helen Compton	3	10 min.	9:40-9:50
6.	The Bausch and Lomb Science Award	Nancy Norman	7	5 min.	9:50-9:55
7.	Travelling Teacherettes	Beverly Bowman Nancy Norman	2	15 min.	9:55-10:10
8.	Jackson Memorial Cancer Research Laboratory Program	Robert Craig	3	10 min.	10:10-10:20
9.	Science Seminar Society	Nancy Norman	7	10 min.	10:20-10:30
10.	Running a Science Fair	Artistides Cagos	2	10 min.	10:30-10:40
11.	Preparation for Westinghouse Science Talent Search	Richard Calusdian	7	10 min.	10:40-10:50
12.	Educative Growth—Modern Marks With Meaning	Robert D. MacCurdy	3	5 min.	10:50-10:55

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ELEMENTARY TEACHERS will be interested in two new publications of the Association for Childhood Education International, 1200 Fifteenth Street, N. W., Washington 5, D. C. They are *Science for Children and Teachers* by Herbert S. Zim and *A Bibliography of Books for Children.* The first of these costs 75 cents, the second $1.00. The science section of the bibliography includes 23 pages of titles on a wide variety of topics.

"What the Glaciers Did to Ohio" is the third in the Educational Leaflet Series of the Ohio Division of Geological Survey and the Ohio State University Geological Museum. Earlier leaflets announced in *TST* were requested by science teachers from coast to coast and this one, too, is available for the asking. Write to Mrs. N. B. Marple, Curator of the OSU Geological Museum.

A CAPSULE OF EXCELLENT MATERIAL for the science teacher, both beginner and old-timer, is the *Handbook for Chemistry Assistants.* This handbook was prepared by a committee of the American Chemical Society under the chairmanship of Grant W. Smith of the Pennsylvania State College. The handbook is free for the asking. Write your request to Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pennsylvania.

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Teaching New Developments in Science

RECENT ADVANCES IN AGRICULTURE

By WILLARD JACOBSON

Assistant Professor of the Teaching of Natural Sciences
Teachers College, Columbia University, New York City

YOUNGSTERS are often very interested in new developments in science and technology. A discussion of three-dimensional movies is usually of greater interest than a session limited to finding out how a stereopticon works. The helicopter will likely be of more concern than a free balloon or dirigible, the ball-point pen than a pen with a fountain.

In many cases, new developments in science and technology will have important effects upon the later lives of these youngsters. New jobs, new professions may open up. Youngsters cannot and should not prepare themselves for these jobs unless they first have an opportunity to take a look at some of these new developments and try to understand what they may mean for the future. In addition, all of our young people will have to learn to use and live with these new developments. Television, for example, has had and will continue to have a great influence on our lives. Shouldn't we begin to try to understand this now? What will this mean for me? In teen-age parlance, "Leave us face it", and recognize that one of few places where our young people can look at and consider these new developments is in a science class and with a science teacher.

The study of new developments in science can lead to important developments in our own communities. These new developments can mean greater wealth for the people of a region. One of the prize examples of this is the recent growth of the citrus industry in Florida. New information about the possibilities in the use of chemical trace elements and new developments in the processing and marketing of the fruit have made this into one of the largest sources of agricultural revenue in the state. The schools have a responsibility to investigate the possibilities for the local community opened up by such developments as well as the occupational opportunities that may be involved in these new advances.[1]

[1] Ward Fletcher has described the role of the school in developments such as this in *Resource-Use As Related to Science Education in Florida*. Unpublished Ed.D. Report, Teachers College, Columbia University. See also Fletcher's "Resource-Use Problems and Methods for Exploring Them," *Florida State School Bulletin*, Vol. XIV, No. 3, March 1952, p. 27-45.

Other new advances may be used to raise the physical well-being of people in other regions. However, the developments cannot be used until the people in these communities have the information available. The science teacher along with such other professional people as agricultural teachers, home economics teachers, local health officers, physical education and recreation teachers, and many others, can serve their communities by working with students and other community members to discover and make this kind of information available. Although we may all agree on this point, there are several irksome stumbling-blocks which may dampen our ardor and impede our progress. For example, where can we get information concerning recent developments in science and technology? How can we direct our search and call attention to those developments that may provide opportunities for our youngsters and our communities? How can we work with people to gain access to new information and knowledge?

There are several excellent publications that discuss new developments in science and technology—*The Scientific Monthly* and *Scientific American*, for example. It is hoped that the journal of the National Science Teachers Association—*The Science Teacher*—will also join this category through development of its Public Relations and Product Information inserts. These popular and semi-popular magazines that regularly discuss new developments are often among the most tattered, torn, but widely used of the journals on the magazine racks of our school libraries. Other journals are written in more technical language and are more difficult for the students and the laymen in our communities to read and understand. However, one of the primary functions of the science teacher has always been to help people to become aware of and understand such information. As a person who has had unique experiences and has specialized skills he can provide this service for the community. He is a person who should be able to help people to interpret accounts of scientific developments that are often couched in what may seem to be obscure terminology and difficult language. He is the person who may call attention to the possibility of adding

trace elements to the soil to make it more fit for grazing. He may work with other people to find this kind of information and to discover whether it might have some applicability in their own community.

The amount of information concerning new developments in science and technology is tremendous and ever-growing. We have to consciously direct our efforts and make deliberate selections. This selection can be made in several ways. One of the most useful methods, however, is to use the community in which the school is located as a means of approaching these new developments in science and technology. This does not necessarily circumscribe and limit our study of new developments in science and technology. Instead, it helps us to focus our attention upon those new developments that may be of greatest interest to students and most likely to affect their lives. It gives us a frame of reference by which we can direct our efforts and focus our search.

How can we do this? There are several questions that can direct our study of new developments in science and technology in almost any community. The standard of living in a community is basically dependent upon the natural resources that are available. What are the possible natural resources in our community, and what new steps are being taken to develop them? If we live in a desert area near salt water, we may want to focus our attention upon new developments for converting salt water to fresh water for irrigation. If we live in an area of forest and lumbering, we can investigate new methods of fighting such afflictions as white pine blister rust or the Dutch elm disease. Some communities depend upon the fisheries. How is the supply of fish holding out? What is being done about such infestations as the Lamprey eel? In seaboard communities, How is our harbor to be developed? Kept free of silt? What new techniques are being developed for navigation and traffic control within the port?

We can also take a look at the major industries in our community. If it is dairying, what are the new developments in herd sanitation and what means are being used to ensure clean milk? How do these chemicals work? In communities where there are large factories, we may want to take a look at the new developments in their products. What changes are being contemplated in the new models of automobiles and why? New developments in radio, television, and home appliances are, of course, pertinent in almost all communities. The major natural resources in our community, the local industries and our own homes can be the springboards for our study of new developments in science and technology. New developments in these areas are quite likely to affect us, and, therefore, we should know something about them.

To utilize new information and knowledge to change our ways of working and living is a very serious matter and should be undertaken only after a great deal of thought and test. One of the simplest, but most profound ways of suggesting change in a community involves a pilot test of an idea on a small scale. If a new variety of seed corn is available it can be planted on a test plot and compared with other types. If new ideas for home lighting are developed, they can be tried out in the classroom or in some student's room. If a group has succeeded in raising a species of fruit from some other country or some new nutritious vegetable, they may serve it in the school cafeteria or at some community function. A pilot demonstration on a small scale tests whether a new development is applicable or desirable in a particular community. The results of the test can be evident to everyone. The development may be rejected, or it may be chosen for a test on a larger scale.

Our study of new developments in science and technology can help us to look at science from new points of view. Our view may be ***historical***. All of these new developments have a history. Sometimes we will want to try to understand the people who have been most responsible for these new developments. We may want to try to comprehend their reasons for devoting time and energy in these directions. It is often revealing to become cognizant of the special obstacles that have been faced and how they have been circumvented. Our approach will also be ***operational***. That is, how does this new development work? What are its possibilities? In the example that follows on antibiotics as growth stimulants, we are not certain how they stimulate growth. We can conjecture and make crude guesses. In the case of soil conditioners, we have more revealing information. In both cases we are getting a clearer picture of the new possibilities that are being opened up. Our approach can also be *social*. That is, we can consider the implications and impact of these new developments for ourselves and our communities. Thus, we can begin to consider how these developments can best be used for our welfare.

Two New Developments in Agriculture

New techniques and products for increasing agricultural production are being developed at an accelerated rate. This discussion of two new advances in agriculture is an example of the kind of informa-

tion science students and teachers will find when they make a study of the new developments in science and technology that may be of value in their community. These new developments—soil conditioners and antibiotics—are of special importance in communities where the soil is a significant natural resource and animals such as chickens, pigs, and possibly cattle are an important source of food and income.

1. Antibiotics as growth stimulants.

For a long time we have known that there is a certain factor in animal protein that is conducive to growth. Chickens fed on a pure vegetable type ration do not grow as rapidly as those that are fed a ration that contains some animal matter such as fish scraps or other meat products. For years this improved growth was said to be the result of an animal protein factor (APF). We recognized a growth factor, but did not understand how it worked. A common procedure in such a case is to apply a name to the phenomena, which in this case was APF. We could now talk about it, but our explanations and understandings left much to be desired. However, in 1948 research workers were able to isolate vitamin B_{12} as a major constituent of APF. The next step was to feed vitamin B_{12} to animals to see if it was the growth factor to be found in APF. To do this, pure vitamin B_{12} was added to a vegetable type ration. When this ration of vegetable protein plus vitamin B_{12} was fed to young chickens, it was found that it was about as conducive to growth as the animal protein factor.

It is at this point that a merger of two seemingly unrelated lines of development has given us an even more important growth stimulant. One of the most important discoveries in medicine in the last few years has been the development of antibiotics. An antibiotic is an organic chemical substance that can be used to check the growth of viruses, fungi, or bacteria. Antibiotics are now being produced in quantities. It had been found that vitamin B_{12} could be extracted from the wastes of the antibiotic vats. Since there was no need to have pure vitamin B_{12} to mix with vegetable rations, some of the wastes from the antibiotic industry were mixed directly with the vegetable rations.

The amazing thing that happened was that animals fed rations that included some of the wastes from the antibiotic vats grew considerably faster than they would have if only vitamin B_{12} had been added. Something new had been added which further stimulated growth. This new factor was found to be some of the various antibiotics that were still left in the wastes.

This is one of our best examples of how two independent lines of research can merge to give us new and important developments. In this case, the animal protein factor which was conducive to rapid growth was identified as vitamin B_{12}. In the search for inexpensive sources of vitamin B_{12}, attention became centered on the wastes produced by the new antibiotic industry. These wastes were added to our animal rations, and it was found that they were conducive to growth over and above that which could be attributed to the addition of vitamin B_{12}.

We really do not know how antibiotics act as growth stimulants. One of the most reasonable suggestions is that antibiotics tend to curb the growth of harmful microorganisms in the intestinal tracts. Experiments with plant growth, however, lead us to question this. Plant tissues in which all microorganisms have been killed still show signs of growth stimulation when treated with an antibiotic. This seems to be another instance where we can produce certain results, but we are still unable to describe how these results are obtained. Again, we apply a name to the phenomena so that it can be discussed as we investigate further in our attempt to understand and explain.

Also, we do not understand all of the implications of these developments, but the ones we can perceive are indeed exciting. We will be able to raise more animals. A chicken farmer in Wisconsin stated that he is now able to raise three broods of broilers during the summer instead of two. This meant that his profits were increased by a half and that he had a much greater return on his investment in equipment and buildings. We will also be able to raise animals with a considerable saving in feed. Because of these developments, the amount of feed necessary to raise a chicken to a weight of three pounds has been reduced by 25 per cent in the last ten years. The saving in feed for pigs has been reduced about 5 per cent with the possibility that this saving will be increased as we implant pellets of antibiotics under the skins of piglets before they are weaned. As far as the world food situation is concerned, the possibilities are many and promising. One expert has estimated that antibiotics in hog feed alone could save us two million tons of feed annually in the United States. A similar saving is possible with many other animals. There is also recent evidence that this growth phenomena will occur in animals that mature more slowly such as beef cattle.

If the growth of plants as well as animals can be accelerated, it will mean that large areas of the world that have very short growing seasons will now be suitable for raising new and different crops.

All of this may expand our food raising potential by 10-15 per cent.

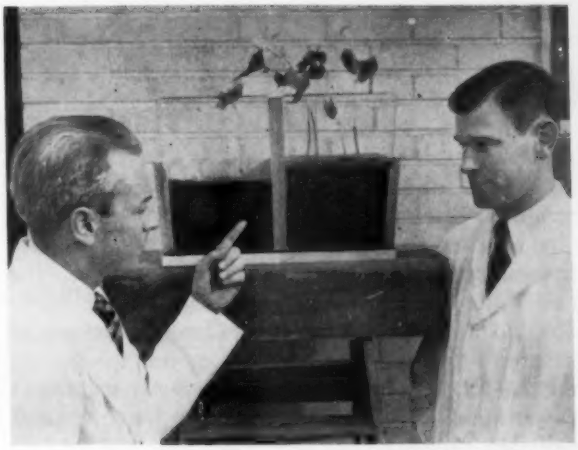
The possibilities for teaching in this area are many. We can try to find out what kinds of feed are being used by farmers in the community. We can also check on the effects that this new feed is having. One farmer who raises a large number of broilers was very enthusiastic when he was interviewed. He had a large investment in equipment and buildings; he felt that this new development would help him to pay his debts five years sooner than he had planned. In communities where there is Smith-Hughes agriculture or an organized 4-H program, excellent opportunities are open for cooperation. Science students may actually test out for themselves the relative effects of feed that contains antibiotics on the rate of growth of animals.

This new development may lead into a consideration of what is involved in scientific advance. Some of these discussions can become quite profound. Are inventions and scientific advance primarily a function of the development of a culture? In the classic example, the steam engine could not be developed until an accurate cylinder-boring device had been invented. In the case of antibiotics as growth stimulants, this could not have been discovered until the antibiotic industry had been developed. The fortunate discovery of vitamin B_{12} in the antibiotic wastes was the link which brought about this merger. An understanding by youngsters of what might be called "cultural readiness," would be profound indeed.

There is also the possibility of considering what words and symbols mean. When we recognized that there was some element in animal protein that was conducive to growth, we first simply called it the "animal protein factor." As we investigated this phenomenon, we made a more precise identification of the factor that influenced growth and termed it vitamin B_{12}. However, this new term helped us to link these growth factors with other developments in the field of antibiotics which led to the remarkable results that have been described. Words and symbols may primarily indicate our comparative ignorance concerning a phenomenon. However, they do help us to talk about a phenomenon and thus to explore it further. This recent development of antibiotics as growth stimulants is an excellent example of this process.

2. Soil Conditioners.

Plants need a soil that has the capacity to hold water. The soil should also be loose enough to allow considerable air to circulate to the roots and to stimulate the growth of the microorganisms whose presence is necessary for optimum growing conditions. In addition, the soil should be sufficiently loose to allow the roots of a plant to penetrate into the soil and for the shoots to emerge without undue difficulty. All of these requirements can best be met by a soil that is crumbly in nature and in which soil particles are held together in small clusters or aggregates. In good soils there are natural binding materials that hold soil particles together. These binding materials are called polyuronides and are derived primarily from the decay of organic materials such as manure and compost. However, in many soils the supply of these binding materials may have been eroded away by wind and water or depleted by the attrition of overuse. It is now possible to provide a synthetic material or soil conditioner which will help to bind soil particles together and make the crumbly-soil condition which is desirable for plant growth.



MONSANTO CHEMICAL COMPANY

Dr. David Mowry, left, and Dr. Mel Hedrick, two Monsanto Chemical Company scientists instrumental in development of Krilium soil conditioner, examine the effects of Krilium on soil in which beans have been planted. Seeds planted at left had little success in germinating and emerging. Those at the right germinated and emerged quickly, because the improved porosity and aeration of the treated soil permitted easy access of air and water to plant roots.

This artificial soil conditioner is a water-soluble resin polymer which was originally given the trade name Krilium. It acts to bind together the very small clay particles by an electrical attraction to form larger aggregates of soil. Krilium is water soluble so that it can be dispersed in the soil. However, once it has formed these aggregates of soil, the attractive forces between it and the clay particles are so great that water will not leach it out of the soil. This is in contrast to the natural binding materials which are easily leached out. Since

Krilium tends to remain in the soil, new binding materials should not have to be added so often. A soil that has been treated with Krilium should stay in good "condition" for a number of years.

Krilium is primarily effective in cultivated clay soils that tend to cake and harden after rains. In these soils the soil conditioner binds together many small particles of clay to form larger aggregates. The effect of this in terms of soil condition is quite pronounced. Less water runs off. Instead, the rain water is absorbed by the soil and made available to the plants. Because fewer cracks and fissures form and the capillary pores are not as continuous there is also much less water lost through evaporation. This gives the soil a much greater moisture capacity. In dry areas this will lead to lowered irrigation costs. In areas where there are great fluctuations in the amount of rainfall, there will be less periodic strain on plants. Plants are more likely to have an adequate amount of water throughout the entire growing season. It is also easier for plant roots to penetrate into soil that has been "conditioned." Now, root crops such as carrots and beets can be raised in clayey soils that would ordinarily be too hard and impervious for roots to penetrate. Hard crusts are also less likely to form on soil that has been treated with Krilium. This makes it easier for the new sprouts to break the surface. The surface of the conditioned soil appears dry much sooner after a hard rain, and it can be tilled and worked after a very short time.

The effects of soil conditioners upon the various kinds of soil can be tested in almost any science classroom. We have devised and tested various simple methods and techniques in our science teaching laboratories. The suggestions that follow can be altered and revised to make use of whatever kind of equipment may be available and to fit local conditions. It should be stressed that the following suggestions are primarily means for testing Krilium in the soil to be found in the local community. Soil conditioners are still relatively expensive, and they cannot be used on a large scale. However, they are available for use in flower pots, seedbeds, and small gardens. We can test the soils that will be used in our small gardens, seedbeds, and flower pots for the effects that Krilium will have in terms of soil structure, water holding capacity, ease of cultivation, and for its effect on the growth of various kinds of plants.

Comparative loss of water by evaporation.

Take two identical samples of local soil for testing. Treat one of the samples with a small amount of soil conditioner. Weigh out equal amounts of treated and untreated soil and place the samples in separate containers. Compare the weights of the samples at regular intervals over a period of 10-15 days. Which sample loses water more rapidly? In general, it is desirable to have a soil that can hold water. If soil treated with Krilium holds water better than untreated soil, it may be that the addition of a conditioner to our soil will help to protect our crops during extended periods of dry weather.

The comparative slacking of treated and untreated soil.

Take a sample of the soil that is to be tested and mix in a small amount of soil conditioner. Place the sample in a large beaker or jar. Place an equal sample of untreated soil on the bottom of another jar or beaker. Cover both mounds of soil with water. What happens? In which soil is there the greater disintegration of soil crumbs? Place equal amounts of treated and untreated soil in separate flower pots. Fill both pots with water. In which pot does the water recede the faster? After the water has receded, compare the soil surface. Which is harder? Which is the more crumbly? It is usually desirable to have a soil in which the "crumbles" do not disintegrate when they are exposed to water. Generally, plants will grow better if a hard surface does not form over the soil when it rains. Does the addition of a soil conditioner improve the stability of the local soil that is being tested? If it does, there may be some advantages to treating the soil with a soil conditioner.

Comparative effect on plant growth.

It is of greatest importance to check on actual plant growth in treated and untreated soil. Some of the soil from the field or garden in which we intend to plant may be treated with the soil conditioner. Fill one flower pot with treated soil and another with untreated. Terraria with glass sides may be substituted for flower pots in order to observe comparative root development. Place a few peas in each of the samples. Water the soil and then watch the seeds sprout and the plants grow. In which sample did the sprouts seem to have the greater difficulty in emerging? In which sample are the roots best developed? And then the important question: In which sample did the plant seem to prosper and grow better? If further tests are possible or desirable, try some root crop such as carrots or beets. This, of course, is a small laboratory test of the effect that the addition of a soil conditioner may have on plant growth in our local soils.

Elementary Schools and Colleges Cooperate to Provide . . .

GARDEN MAGIC FOR THOUSANDS MORE

By BARBARA SHALUCHA

Assistant Professor of Botany, Indiana University, Bloomington

FROM THE MOMENT the big garden gate swings open in early April, work becomes recreation for 150 boys and girls of Bloomington, Indiana, and for their annual crop of garden teachers. This unique outdoor laboratory known as the Junior Garden Workshop is an integral part of the horticultural training offered by the botany department of Indiana University.

For the past four years, scores of young men and women have been leaving the campus with a treasury of field experiences in a leisure-time science program . . . carrying away a living pattern for making knowledge useful in the lives of the people with whom they will be living and working. In an atmosphere of intensive scientific research, this university program bespeaks a significant movement in science education training for our young leaders.

This is a community project, supported by the city department of recreation, Indiana University, and the Bloomington Garden Club. It enables the city to present gardening as a leisure-time program for its school children in spring and summer. The project also permits the University to offer its students experience for similar responsibilities in their vocations. Some are training for recreation leadership and know that gardening programs for both adults and youth are often sponsored by recreation centers or industries which may employ them. Some may be preparing for the teaching profession; they now have a chance to witness the fact that elementary and secondary schools can invigorate learning in the classroom through the science of gardening. Others may be preparing for careers in social work, keenly aware of youth and programs designed to keep minds and bodies busy in pleasant and constructive pursuits.

Our over-all pattern is simple and flexible. It gives the student garden teacher an opportunity to devote his time to the teaching of horticulture and learning to interpret the significance of such a program throughout the country. For boys and girls, it provides for their development of responsibility, appreciation of work, and growth in character. The student teacher learns by experience that "knowing his subject" is not enough and that he must like working with young people; only then can he begin to understand our basic philosophy, that "Children Grow In Gardens."

Garden time is announced through the school system in March. Boys and girls between nine and 12 years of age who enjoy the out-of-doors are eligible for membership which may be renewed annually until graduation from high school.

The garden teachers—twenty-five of them last spring—are trained in-service and they are in complete charge of their groups of young gardeners throughout the spring season. Once a week they meet to share experiences and to plan for the next lesson. There is no smarter detective than our young gardener, for he can sense whether we are ready for him as soon as he arrives each Saturday morning.

One of the most important lessons a junior gardener learns in this leisure-time program is to stop a moment and think before he goes into action. When drawing up garden plans, the garden teachers hear chorus after chorus of "Oh . . . I want to plant lots of carrots, beets . . . oh, and hundreds of everything!" Good! And so they let the gardeners talk. Soon, they direct these big ideas on

paper and then with careful guidance the hundreds of everything become discarded. This valuable lesson is recorded on paper simply and clearly in the form of a garden plan. This lesson continues with the eventual plan "in action" during planting time.

Outdoor gardening begins late in March for the university student. On Planting Day in late April, the garden teachers introduce garden principles to the young gardeners by using a pattern, their own 10′ x 10′ plots.

Discipline is never a problem, for everyone is busy and happily so. On disappointing Saturdays when it is impossible to be out in the garden, the indoor lessons continue just as interesting as the outdoor ones because the leaders know how to draw upon the young gardeners' imagination, making scientific facts important, for a pocketful of "know-how" may produce a bumper crop.

With school out, the gardening program assumes an important role in the child's life and in the well-being of the community. Under the direction of four student supervisors and guided by those responsible for the Workshop, the program swings into action with gardening twice a week and nature exploration on every Saturday morning. The garden periods are devoted to either the care of their vegetable plots or to the fulfillment of requirements in the Honor Work Plan. We realize the role of competition all around us, some of it good and some bad. Our program recognizes the value of such a factor but we see that a little goes a long way.

Under the Honor Work Plan, the gardener is initiated into many activities in the Big Garden. The flower border at the end of the season holds several favorites. The herb garden has given him a chance to take home herbs for mother. He has discovered that it is fun to help weed other people's gardens, for there are many such jobs when his buddies are away on their vacation. Fun? Of course! The garden teachers, especially chosen for this job, know that Billy is going to learn to help others *unasked* and to do it "for fun," as he puts it later. The garden season is concluded with the awarding of honors at a special program planned by the Garden Club women who are working as a team so that in this state and wherever the Indiana University students go, there will be trained leadership to help "Children Grow In Gardens."

How rich are the harvests for the junior gardener? From his garden plot, 10′ x 10′, he has supplied food for home use. He has learned to prepare soil for planting; how to fertilize the garden; how to make and interpret a garden plan; how to cultivate and why; how to thin and why; how to spray and for what bug or disease; how to care for his tools. But, most important is that he has done it with other boys and girls, sharing the fun and fellowship in working together.

The students who have directed this educational program of far-reaching social implications—have they too shared in the bountiful harvests? It has been a summer full of hard work, the keystone to any successful program; they leave with a sound working knowledge of this pattern. They have been introduced to the many different ways of getting along with people, young and old; they have acquired a little deeper understanding of human frailties. But, most important is that these young leaders have been introduced to the "magic" of gardening, its art and science, for youth. It is here where they lead boys and girls to discover that there is dignity in work, a noble quality for today's living.

"A child may read about rocks . . . but . . . climbing such a bank is an unforgettable experience."

Elementary Science Field Trips

By ELSIE MICHEL

Museum Teacher, Cleveland, Ohio, Museum of Natural History
(Employed by the Cleveland Board of Education)

CLEVELAND IS FORTUNATE in having a teacher appointed by the Board of Education assigned to the Cleveland Museum of Natural History. This plan affords the teachers from the Cleveland Public Schools the opportunity to bring their classes to the museum for lessons correlated with the classroom science units. The museum teacher plans the lessons in advance to assure the children of a valuable as well as an enjoyable experience.

The museum teacher also conducts field trips upon request, and she will accompany classes to one of the municipal or metropolitan parks, which serve as ideal outdoor laboratories.

Unfortunately, there is a limiting factor in Cleveland, as chartered buses are needed to reach most of the park areas. The expense of chartering a bus is met in a number of ways. In some schools a fund is set aside for such an expenditure. In others, the PTA defrays the cost. In still others, the children pay the cost themselves by equally dividing the expense of the bus among them. It is sometimes possible for a child to earn his fare by taking an active part in a school project such as a paper drive. School systems fortunate enough to have their own buses are not handicapped by the transportation problem.

Perhaps you can encourage your community to employ a trained leader to conduct field trips. However, outdoor experiences should not be denied children because a naturalist is not available. A science teacher is capable of conducting her own field trip. Everyone enjoys being outdoors and therefore there is no happier opportunity for learning than a trip to see the spectacular and the stimulating phenomena of nature. When curiosity is uppermost and interest is deep, the children receive unforgettable impressions.

Thoughtful planning and careful organization will be necessary to insure the desired results. It is essential that the teacher visit the location well in advance to determine what is available. This will help prevent any embarrassing situations which might arise from the ever-present questions of the children.

Thought should be given to the type of equipment. Many times too much unnecessary equipment is taken. A decision as to the necessary supplies will be determined by the objective motivating the trip. It may be only a small notebook and pencil, or a hammer and boxes; bags for collecting specimens; killing jars and nets for insect study. The killing jars and nets can be made in advance as a class project. Field glasses and cameras, if available, are always desirable.

It may be effective to organize the class into groups with a child leader assigned to each group in order to keep the children together. In this way the teacher will be free to go from one group to another to point out and interpret any significant feature. This plan will be found useful if the class is large.

An alert leader will never miss the opportunity to capitalize on the natural curiosity of her children. An observant pupil may note something that will provide a good discussion. Pause long enough to give a satisfactory answer if possible. An alert leader will never turn the pupil away by saying that it is not the subject under discussion. She is not ashamed to say that she does not know, but she suggests that it will be a good topic to follow up in the classroom. Trying to evade the question or to give incorrect information is not only bad technique but unfair to the child.

The importance of a field trip as a dynamic learning situation for the study of rock formations cannot be overemphasized. A child may read about rocks, see pictures of them, or even see and handle specimens. However, it is difficult for children to visualize the layered characteristics of sedimentary rocks until they have seen good exposures of these rocks. You may find them in stream cut valleys or road cuts. Climbing such a bank (if safe) is an unforgettable experience. If shale and sandstone are both present, it is easy to see and feel the difference in hardness. If the area visited is one of igneous or metamorphic rocks, the massiveness and hardness of these rocks is apparent. A small specimen examined in the classroom can never convey this impression.

Trips to study rocks will also clarify many of the erosion problems discussed in the classroom.

A field trip well planned, and well executed, is invaluable and stimulates the child's interest in the world about him.

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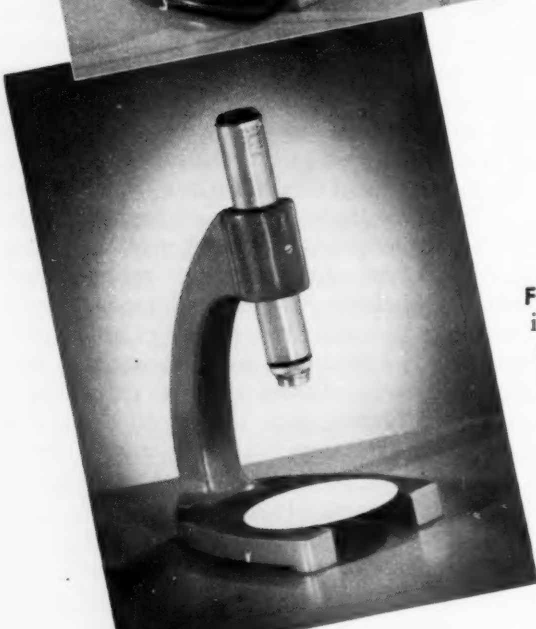

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EISEMAN—continued from page 117

and concisely on the printed page. The answers are channeled into the blanks provided. Many teachers correct them during the laboratory period. If they do correct the papers at home, the task can be quickly accomplished because of the rigid limitations upon form and expression. In other words, faced with the choice between an unsound but expeditious educational device, and a more desirable, but much more time-consuming form, the teachers have elected the former, and the sales of cook-book manuals have boomed. Many teachers would justify laboratory manuals of the cook-book type solely upon the basis of economics of time in grading them.

Before proceeding further, it might be well to outline what is meant above by a more desirable but much more time-consuming form. The laboratory manual should be little more than a guide. It should consist only of minimal directions for performing the experiments. Brevity should be its key. The text of the manual should ask no direct questions. There should be no hints as to what is wanted for an observation or a conclusion. The problem for consideration should not be stated for the student. Where the student can discover the correct procedure or mathematical formulation in his textbook or elsewhere, directions for these should be left out. A few hints as to the desirable form for writing up the conclusions may be included, but these should not imply the answers. They should be flexible enough to allow for individual expression.

To record the results of the experiments, the student should be provided with a blank data sheet. Upon this sheet should be recorded any and all observations that the student can possibly make in the course of the experiment. For quantitative experiments, ruled blanks or columns are acceptable, as long as the column headings do not hint at the correct method of solution. It is felt that the advantages to be gained by encouraging an orderly recording of quantitative figures more than offset any disadvantages incurred by telling the student what to record.

The experiment report should be written up entirely independently of the manual. This may be done on plain blank paper or on a standard school form. At any rate, the write-up should conform to the standard form. The problem should be defined clearly. The experimental procedure should be clearly outlined. The equipment used should be sketched. The data obtained should be neatly summarized. Sample calculations should be required if the experiment is a quantitative one. Finally, the student should be required to list his conclusions, drawing only those that are justified by the experimental data. This experimental report should be done in complete sentences, neatly, and without the use of abbreviations.

With this in mind, it is at once apparent that the argument of the science teachers regarding economy of time in grading is quite a real one. There is no doubt that the suggested form is difficult to read and grade. But, it is also felt that there is little doubt that it is much better for the student. It is, of course, also harder for the student to write than the cook-book type of experiment. However, the fact that it most satisfactorily puts to use the four objectives of high school science laboratory work makes it seem justifiable to recommend this procedure.

In final summary, then, the argument resolves itself quite simply into the following form. What should be the primary consideration in high school science laboratory work? Should we be more concerned with the maintenance of laboratory work as a fine and valuable adjunct to regular classroom work by providing the student with a realistic and useful experience? Or, should the main concern be for our own convenience and welfare?

It appears that this last question itself implies the answer. For that reason, it is strongly urged that science teachers re-examine their current laboratory procedures, and that publishers re-evaluate their products, in light of the person to whom we devote most of our energies—the student.

THE "ANNUAL REPORT FOR 1952" of the Federal Civil Defense Administration is now available from the Superintendent of Documents at a price of 40 cents. Many of its pages will be of interest and help to science teachers. On page 72 there is a nice mention of NSTA.

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HOUGH—continued from page 118

versity curriculum in the Paleolithic Age. For practical reasons the original curriculum consisted of three courses: horse snaring, tiger slaying, and fish grabbing. Long afterward, when the three-toed horses had all been killed when the sabretooth had departed to a climate more to his liking, and when someone had invented the fish net, the curriculum still consisted of courses in horse snaring, tiger slaying, and fish grabbing.

Today when the diesel, the gas engine, the jet, and the turbojet are rapidly displacing the steam engine, we are told: "You have to give major attention to the steam engine and show how it works. Every textbook does. THEY expect it." Or instead of the steam engine substitute air brakes, lift pumps, or coal-tar derivatives, or many another topic that modern technology is making obsolete. The statement that goes right along is: "That's one of the things THEY will look for when they consider the book. If it isn't there, your book won't sell." So you put it in. Then the rut gets deeper and deeper as you go along putting things in because THEY will be looking for them.

The problem is what to do about the power of tradition.

The abstract

In the business of semantics we are taught that about the toughest thing for people to understand is an abstract thought. Science is filled with them, and we spend hours trying to pound these abstracts into young heads. Has anyone ever made a survey to determine the retention period of most of the abstracts taught in science? In industry it would have been done and the material reduced to the level that would make retention more probable. If the retention were not of long enough duration, industry would not spend money trying to get the abstracts through workers' heads.

Why in textbooks and in teaching must we waste time trying to teach abstracts that have meager chance of retention? There are many science ideas in textbooks presented as pure abstractions, and if you think you haven't wasted time trying to teach them, make a little survey of your seniors and find out what they have retained. Even more revealing would be to give a few spot tests just a few days after you try to teach an abstraction.

Of course, some ideas that *must* be presented are essentially abstract. Some abstractions now presented can be made concrete through application. Other abstractions now popular in science courses need not be presented at all.

The problem is how far to go in eliminating abstractions that are not retained by the student but which the teacher or course of study requires.

Encroachment

The authors and publishers of general-science textbooks are constantly confronted with the perplexing problem of how much content to borrow from biology, chemistry, and physics. Teachers of these last-named subjects frequently complain that the general-science teacher "takes the edge off" their courses, robs them of motivating materials by performing the simpler yet more spectacular experiments that properly should be reserved to act as stimulators in these later courses. Some science teachers have even said contemptuously that the general-science course is nothing but a weakened, watered-down emasculation of later courses and that such a course is therefore without educational value or justification.

Problem: Dare a publisher, without risking the loss of his market, produce a general-science text that emphasizes scientific thinking and practical applications of science, omitting those traditional phases of the course that have in the past been taken largely from courses in biology, physics, and chemistry?

Perhaps I have wandered in this discussion. To summarize, the problems are:

1. Can a textbook gain acceptance if it is easy to read; if it does not bother too much to explain things that won't be remembered overnight; if it is practical and makes a serious attempt to teach the scientific method of thinking, using examples that are up-to-date instead of those that are merely traditional?

2. Can a textbook gain acceptance if it slights a course-of-study requirement because that requirement is from another day and age or because it isn't teachable in the first place?

3. To what extent may a general-science text disregard those traditional phases of the course that are based on materials appropriated from courses in biology, physics, and chemistry?

PUBLISHING PROBLEMS IN BIOLOGY

1. How much formal science should be included in the high-school biology course? To what extent should organization and emphasis be determined by social values? To what extent should organization be based on the systematic and the logical? For example, how much organizational emphasis should be given to classification of life forms?

2. How far should the hobby side of biology—biology just for fun—be developed? Some teachers

would accept a considerable emphasis on this phase of the subject. Others care little for pupil interest and think it a waste of time to study hobby biology.

3. To what extent can physiology and health be emphasized without neglecting other worth-while goals of the biology course? Should the biology course make provision for health education, or will a separate course in health be provided?

4. How shall such controversial subjects as evolution and sex education be handled?

5. How much attention should be given to conservation, forestry, plant and animal husbandry? Well, it depends on where you live and on what *your* philosophy is. How much attention should be given to the fact that biology or any other science can reveal some possible future vocations?

6. Many new drugs and serums appear from time to time. They are given big build-ups by leading newspapers and magazines. Some of the sulfas and antibiotics as well as ACTH and cortisone have done wonders in the battle against disease. But what has developed in a fairly short time as far as some of these products are concerned? Many claims were far too optimistic—even those made by members of the medical profession. Some of these wonder drugs have proved to be dangerous. Some have caused bad after-effects, and some have just become ineffectual—their usefulness vanished. Problem: How much should a textbook emphasize these new topics? How much dare an author include, even though his information comes from the most authoritative sources?

These are but a few of the problems confronting the author and publisher of a biology text.

This paper has already become too long, and special problems confronting the authors and publishers of physics and chemistry texts have not been specifically treated. Many of those problems have, however, been suggested in the foregoing discussion. One large problem—over-shadowing all others in the publication of physics and chemistry texts—is this: What can authors and publishers do to textbooks in these subjects to help increase the popularity of these courses? What can be done to induce high-school pupils to enroll? How can we dispel the generally prevailing impression that these subjects are dull, exceedingly difficult, and elected only by "grinds" and "jerks"?

If that problem can be solved, a very worthy social service will have been performed and, incidentally, the publishing of chemistry and physics texts may become a venture on which the author and publisher can at least break even. It is very precarious now.

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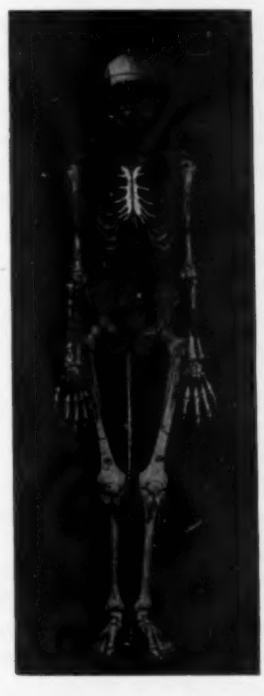

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JOHNSON—continued from page 119

budget for these pre-publication expenses for an attractive, modern biology text might look something like this:

Typesetting	$ 5,700.00
Artwork and photographs	3,000.00
Engravings	15,000.00
Printing plates	3,500.00
Salaries and other editorial expenses	5,000.00
Total	$32,200.00

Publishers today are investing 7.3 percent of their income, on the average, in these pre-publication expenses. With such an investment base a publisher will have to sell a gross dollar volume about fourteen times his initial investment or, at today's current average net wholesale price for a biology text, about 175,000 copies to recover his initial investment! This is a staggering undertaking when you consider that the 1949 total U. S. enrollment in high school biology courses was only 996,000 students. If one student in every six received a new text that year—(This is a loose but widely accepted estimate. The truth is—no one knows *exactly* how many biology students receive new texts each year.)—only 166,000 new texts were sold in 1949, and twenty-five (remember!) separate titles were competing for selection. If each title were to receive exactly 1/25 of the market (and of course such an equal division would, in actual fact, never occur) the sale *per title* would be only 6500 copies!

Even though the mathematics of the preceding paragraph is rather hypothetical, the risk the publisher runs is not. It is a chancy, long risk even in a vigorously growing field such as high school biology.

A publisher, weighing the risk before accepting a promising new manuscript, is bound to consider not only your actual need for his prospective material, but the state of your purse as well. This is particularly true if the material is unique—a sharp departure from tradition, or is a reference or supplementary aid. If our publisher's judgment is sound, if he maintains his perspective despite growing enrollments and monitory inflation, what he sees gives him sharp pause.

What really counts is the relation of your school's textbook budget to the number of pupils enrolled, and the actual purchasing power of the dollars making up its total. Every state and local school district's picture is individual, but the over-all national record is alarming. Here, in the table below, is this record, expressed in *dollars of constant purchasing power.*

AVERAGE PER PUPIL EXPENDITURES FOR PRINTED INSTRUCTIONAL AIDS

(Expressed in dollars of constant value)

1946	= $1.93	1949	= $1.81
1947	= 1.80	1950	= 1.91
1948	= 1.80	1951	= 1.75

$1.00 = $1.00 in 1939, using its purchasing power in textbooks only, and not in purchasng other commodities.

You will see that, even with a very slight increase in 1949 and a slight spurt in 1950, we have been spending less per child *every year* than we spent for that item in 1946.

A fascinating experiment I hope the American schools will sometime make would be to increase the average per-pupil textbook expenditure by one full dollar. Those of you who are searching for greater variety in your texts, and for more supplementary materials with broader coverage would be pleased to see the supply increasing as your textbook budget grew. But, as you can see from the preceding table, the cold bleak fact is that today we are not appropriating enough now to satisfy even our most elementary needs for printed materials of instruction.

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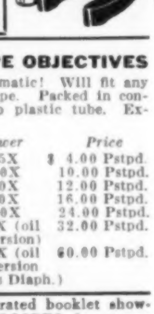

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30,049-AC	60X	24.00 Pstpd.
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WAREHAM—continued from page 119

of one of the previous speakers on this panel. I shall dwell on this aspect no longer.

The author every publisher is looking for will write so clearly that even the editors can understand what he is driving at. His sentences will be short and most of them will be simple. He will use subordinate clauses sparingly. He will use the most familiar synonym if there is a choice. He will address himself to his hoped for readers, the students, not to his contemporary teachers or to his erstwhile professors. His aim will be to inform youth or lead them to inform themselves, not to turn a series of beautiful phrases. He will avoid cliches and circumlocutions. The facts and lore of science are so interesting in themselves and in their relationships to the individual and to society that embellishments of almost any kind are detracting. He will be grammatical. And since hardly any author can judge his own manuscript against these standards he will ask his students, his fellow teachers, anyone who will take the time, to judge it for him. He will then rewrite where necessary.

An inexperienced author should not begin to write a textbook until he has read *The Art of Readable Writing* by Rudolf Flesch, published by Harper & Brothers (1949). In this book Dr. Flesch shows many examples of good, clear, unambiguous writing alongside examples of poor, muddy, difficult-to-read prose. He not only gives excellent helps for the author who wants to write clear, easy-to-read English but also provides a formula and scale by which to judge readability. Perhaps all of you know of George Mallinson's studies of the readability of science textbooks. All his studies were made by use of the Flesch formula.

The author every publisher is looking for will make his manuscript accurate. For facts he will not depend on his memory of high school or college courses taken fifteen or forty years ago. Memory is faulty; researchers make progress. Few people can be truly up to date and surely informed in more than a small portion of the subject matter covered in our elementary and secondary school textbooks. The author will have to check his facts with up-to-date reference books. Then as a double check he will see to it that some expert checks, especially his generalities, for important exceptions. A book that is accurate in all its parts will be consistent. Our hypothetical author will not deny on page 91 a statement he made on page 23. Inconsistencies arise principally because an author cannot write 180,000 words at one sitting or because of coauthorship, though some are due to other causes. The author, or both authors, or all authors should read the whole manuscript in as few sittings as possible after it is completed, marking passages that seem to be out of line. He will then go back and bring these passages into line with the rest of the manuscript.

The author every publisher is looking for will be informed as to the methods of teaching recommended by the majority of supervisors of science teaching in the United States. He will present his material so as to help and stimulate the overloaded and the inexperienced teacher, as well as the experienced teacher, to do a good job in the science classroom. Doing a good job means teaching so that every kid in the class learns as much as his ability and time will allow. I think it also means that some laboratory, or at least demonstration, experiments are performed and that they are used to teach how to observe, to classify, to generalize. The text our author writes, therefore, will help stimulate the brilliant as well as his less gifted classmates; and it will stimulate them either directly or through the teacher to *do* something. I need not remind you that this requirement is one of the most difficult to satisfy.

The author every publisher is looking for will make his manuscript mechanically perfect and according to the publisher's specifications. Because the problems of editors are similar, all publisher's specifications are similar. Nearly all specifications are designed to make the job of editing and of marking manuscript for the printer as easy and fast as possible. If you are an author already under contract, your publisher will supply you with his specifications. The principal requirements in general are:

(1) Manuscript should be typewritten, double spaced, on 8½" x 11" bond paper of good quality. Margins should be generous and equal on all sheets.

Typewritten because typewriting is easier to read than most handwriting.

Double spaced to make it easier to catch and to correct errors in spelling, punctuation, grammar.

Wide margins for notes to the author, instructions to the printer, and possible corrections.

Equal margins because that means equal-length lines, which is important in estimating the length of a manuscript.

Good paper because manuscript is handled, shuffled, and shipped numerous times before the publisher, printer, and author are through with it. There is also always the possibility that the author will become famous and that his manuscript will become valuable. Cheap paper yellows and becomes brittle with age.

8½ x 11 in size because this size is standard, fits in folders, in typesetters' copyholders, in standard Manila envelopes.

(2) Literature citations, or references, should be according to some standard scheme. Some publishers have adopted a standard scheme for all their books.

(3) Headings, i.e., titles, subtitles, section titles, paragraph titles, etc., should be clearly marked as to rank.

There are other details such as to footnotes and illustrations, but all these can be obtained either from the publisher if the author is under contract or from a number of excellent books written for the guidance of authors. I can recommend Perrin's *Writer's Guide and Index to English* published by Scott, Foresman (1950), *A Manual of Style* published by University of Chicago Press (1949), and *Words Into Type* published by Appleton-Century-Crofts (1948).

I am sure none of you expected a three-hour college course in good writing in the fifteen minutes allotted to me on this panel. What I have tried to do is to highlight some of the criteria by which a publisher judges a manuscript.

If you are not an author or planning to become an author, some of these criteria may help you in selecting a textbook. I have tried to say that, although a textbook to be a profitable publishing venture must be a compromise as to content, it should be clearly written and pitched to the level of the reader to whom it is addressed. It should be accurate; and that means consistent and up to date as to content. It should also be up to date as to methodology, neither ahead of nor behind its time. I have tried also to give some hints about how to go about writing a textbook, though I have far from exhausted this subject. I am sure that if any of you have a yen to write a better book, and have the energy to devote to it, you can get an attentive ear from any one or all of the dozens of textbook publishers in the business. And good luck to you.

WE NOTED WITH INTEREST the February 2 membership report of the National Council of Teachers of Mathematics (also an NEA department). The count shows 6971 individual members and 2208 institutional members (libraries, schools, etc.), a total of 9179. Congratulations to our mathematical colleagues! NSTA is still trying and as of March 10 had reached a new all-time high. However, math is still running about 35 per cent ahead of science. How long can this go on?

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Book Reviews

Psychology and Its Bearing on Education. C. W. Valentine. 674 pp. $6.00. Philosophical Library. New York. 1951.

This new book by an Emeritus Professor of Education in the University of Birmingham, England, is a valuable contribution to the literature of elementary psychology and its application to the field of education.

The general subject-matter differs not greatly if at all from that of other acceptable textbooks in educational psychology.

In justification of this new volume, it may be said that the scholarship of the author is eminently sound; that his consideration of each problem, controversial or other, is impartial and thorough; that the organization of his material is consistently superior; and that his literary style is lucid and clear.

Professor Valentine is not an adherent or advocate of any one of the several controversial schools of psychology. His approach is rather that of a scientist attempting to present the facts fairly so that he and his readers can make their own appraisals and form their own sound judgments.

Colin McEwen
Colin McEwen School
Hollywood, California

Science in Everyday Life. Ellsworth S. Obourn, Elwood D. Heiss, and Gaylord C. Montgomery, 620 pages. $3.80. D. Van Nostrand Company, Inc. New York. 1953.

If you are now or soon will be considering the adoption of a textbook of general science for eighth or ninth grade, your task has become a bit more involved through the addition of this new book to the field—it's just that good, in the opinion of this reviewer.

Apparently capitalizing on students' natural interest in everyday things, the book stresses basic facts and principles. Lots of activities interspersed throughout the text give it an "activity book" flavor. These things to do give students opportunities to experiment, collect, organize, interpret, and evaluate and to apply the results of these activities. The authors have not yielded to include all known scientific knowledge and their selection of content, in this reviewer's opinion (recalling his own teaching-days contacts with youngsters), looks pretty good.

The teaching and learning aids at the ends of chapters and ends of units seem simple enough, complete enough, and varied enough to be useful to one and all. They include recall questions, summaries of important ideas, questions for discussion, practice in problem solving, additional things to do, and suggestions for reports, books to read, investigations, etc. A Teacher's Guide and Key are now available. A Workbook is in preparation.

This reviewer's application of the Flesch formula (as given in *How to Test Readability* by Rudolf Flesch, Harper and Brothers, 1951) gave an Overall Readability score of 70. According to Mr. Flesch, this makes the book "fairly easy" and pitched to "7th or 8th grade" reading ability. The book is well illustrated and the publishers have done a good job of book making.

But what book review ever closed without at least one criticism? Here are two picayunish ones: Isn't air a material (rather than a "substance," as in question 4 on page 34), and isn't it a four-stroke cycle engine (rather than a "four-cycle engine," as in Fig. 10-18 on page 249)?

Robert H. Carleton
National Science Teachers Association
Washington, D. C.

Elements of Social Organization. Raymond Firth. 257 pp. $5.75. Philosophical Library. New York. 1951.

Elements of Social Organization comprises in substance the Josiah Mason Lectures delivered by Professor Firth at the University of Birmingham, England, during the Spring Term of 1947.

The Lectureship was founded in the University of Birmingham by the Rationalist Press Association, in commemoration of Sir Josiah Mason, a prominent Rationalist. The Lectures are to illustrate the scientific approach to the problems of civilized society.

In this book, the material of the lectures has been revised and some of it has been expanded considerably to give greater understanding.

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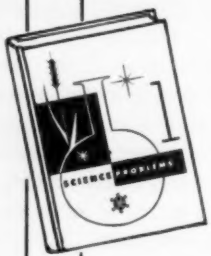
for everyday living and thinking



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The author emphasizes the relation between modern world situations and the primary observational field of social anthropologists, this primary observational field being the simpler, more "primitive" societies and cultures. He also discusses the point of view of the social anthropologist in regard to the concepts and values in four important fields of human social activity—economics, art, morals, and religion.

The emphasis throughout is on the scientific approach to the problems of life and living. Fortunately, moreover, Professor Firth writes with clarity as well as sound scholarship.

Colin McEwen
Colin McEwen School
Hollywood, California

Books Received

THE COMMON SENSE OF SCIENCE. J. Bronowski. 154 pp. $2.00. Harvard University Press. Cambridge, Massachusetts. 1953.

An attempt to help the layman perceive the ideas behind the technical jargon of science. A book about the essential nature of science, how it appears in the life of each of us today, and how its methods can be used in all we do.

MORE MODERN WONDERS AND HOW THEY WORK. Burr W. Leyson. 192 pp. $3.50. E. P. Dutton & Co., Inc. New York City. 1952.

Descriptive accounts, often historical, of how many mechanical and scientific things and "gadgets" work Included are the modern rifle, locks and locking devices, UHF, hydraulic automobile transmissions, the phonograph record, etc.

AUGUSTINE TO GALILEO. A. C. Crombie. 436 pp. $9.00. The British Book Centre, Inc. New York City. 1953.

A history of science from A. D. 400-1650, presenting the author's view that one system of scientific thought gives place to another not so much because men discover new facts but often because, for some reason, they begin to look at long familiar evidence in a new way.

WIND, STORM AND RAIN. Denning Miller. 178 pp. $3.95. Coward-McCann, Inc. New York City. 1952.

A story of weather "written to give the average citizen an opportunity to peek behind the scenes of the weather's dramatic show."

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